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REPORT OF

Ontario

THE BUREAU OF MINES

VOLUME VIII—SECOND PART

1899

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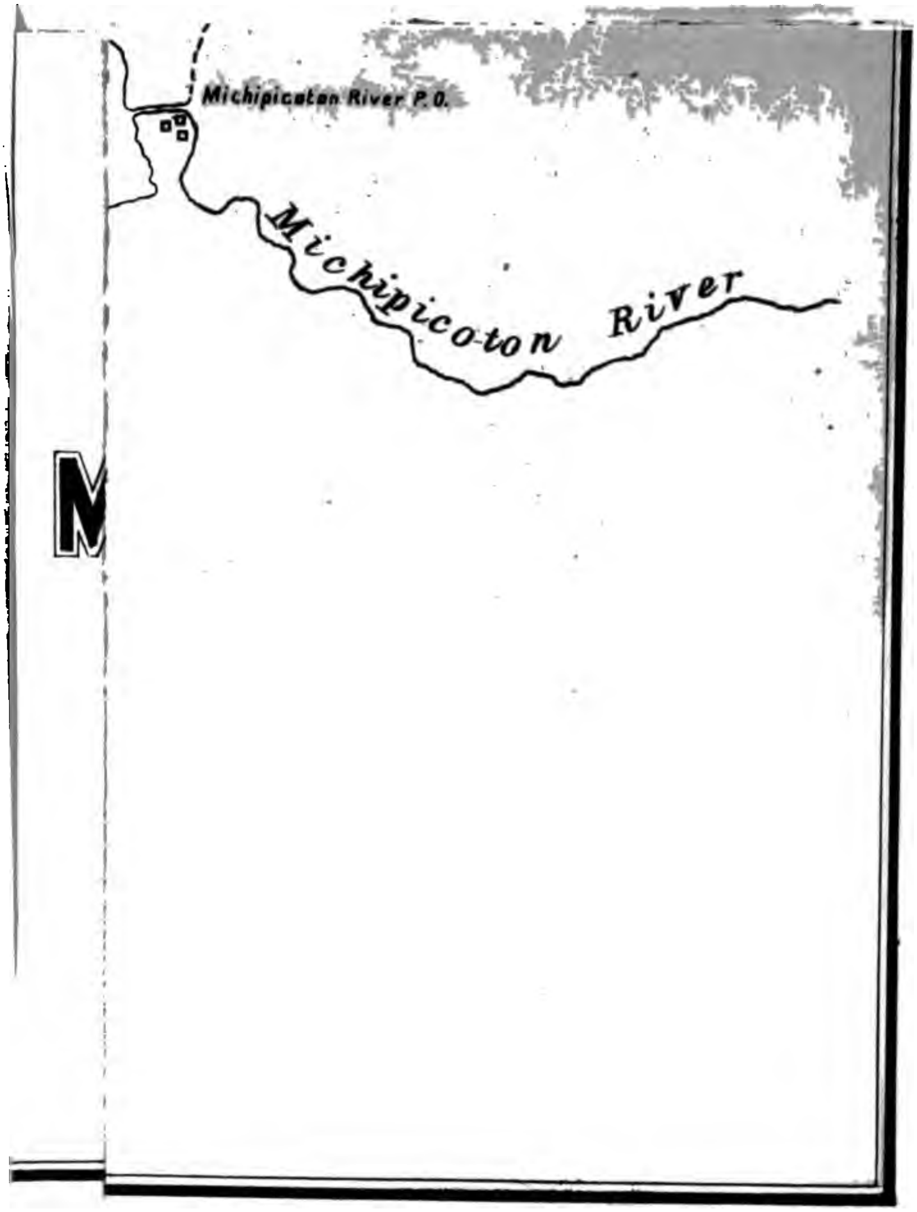
INTRODUCTORY NOTE.

The following table presents by quantities and values the statistics of metallic production in Ontario for nine months ending September 30, 1899, and for twelve months ending December 31 in the years 1896 and 1893 respectively :

Metals.	1899 (9 mos.)		1896 (12 mos.)		1893 (12 mos.)	
	oz.	$	oz.	$	oz.	$
Gold	20,210	318,212	7,154	121,848	1,635	32,900
Silver	98,000	58,800	....	... ...	....	....
	lb.		lb.		lb.	
Nickel	4,608,000	566,633	3,897,000	357,000	3,306,000	454,702
Copper	4,642,000		3,736,000	130,660	2,862,000	115,260
	tons.		tons.		tons.	
Pig Iron	48,216	693,155	28,302	353,780	....	......

No silver was produced in the Province in 1893 or 1896. The mines were closed down in 1892 and were not re-opened until 1898. The first production of pig iron after an interval of more than thirty years was in 1896, and the first production of gold after almost as long an interval was in 1892. The total value of metallic products in 1893 was $602,862 and in 1896 $963,288. For the nine months of the present year it has been $1,637,100, and if the same rate of production be maintained to the end of the year it will reach $2,200,000. The total value of the metals produced in the Province for the twelve months of last year was $1,655,968, made up of $290,919 gold, $51,960 silver, $514,220 nickel, $268,080 copper, and $530,789 pig iron. The revenue from sales and leases of mineral lands has been $147,666 for the nine months of the present year, as compared with $97,762 for the whole of 1898, $40,588 for 1896 and $26,159 for 1893.

Part II. contains in addition to the Reports of Dr. Coleman on the Copper Regions of the Upper Lakes, of Mr. Parks on the Nipissing-Algoma Boundary, of Prof. Miller on Corundum, etc., special Reports of work done during the present year on the Michipicoton Iron Range, on Copper deposits in Parry Sound, and on the Lower Seine Gold Mines A. B.


Michipicoton River P.O.
Michipicoton River
M

COPPER REGIONS OF THE UPPER LAKES.

By Dr. A. P. Coleman.

Introduction.

accordance with the instructions of Mr. rchibald Blue, Director of the Bureau of s, last summer's work was devoted to amination of the rocks on the north nel at the northwest end of lake Huron, f the northeast shore of lake Superior, special reference to the copper deposits region. Professor Arthur B. Willmott, cMaster University, was once more appointed assistant geologist and proved as helpful and efficient as on former occasions. Messrs. R. oulthard and R D. George, B.A., were inted junior assistants and rendered ble service during the summer's work. modes of travel were more varied than l owing to the different type of country hich we were employed, part of it more s settled, with backwoods roads passable wheeled vehicles, and another part ble of being traversed only with canoes ; the main portion of our travel along tormy shore of lake Superior was pered in a Collingwood skiff manned by kilful French-speaking fishermen from Ste. Marie, Edward Sayers serving as in and Stephen Jollineau as seaman and . Both did their work satisfactorily. raft, the Caribou, carried only two fore ft sails and had very little accommodaunder the deck covering the bow, so that ad to camp at night at some harbor or . She was safe as handled by Sayers proved a good sailor, but very heavy to which occasionally cost us much time labor. Travelling by canoe or row boat many advantages, but on so large a lake perior one runs a certain risk in a small and may lose days in succession by high s. Fortunately there are innumerable l harbors on the wild and rocky north shore of the lake, so that a fishing boat seldom requires to go more than a few miles to find shelter.

General Scope of the Season's Work.

We left Toronto on June 7th and proceeded by way of Collingwood to Sault Ste. Marie. A canoe trip was made down the St. Mary's river as far as Thessalon to examine the rocks of the Huronian as originally defined by Logan, and to visit the copper deposit at Bruce Mines and other points. We then cruised from the "Soo" along the northeast shore of lake Superior, coasting with canoes as much as the weather permitted, and visiting the copper mines near Mamainse. This trip ended at Heron bay, where the Canadian Pacific railway first touches the lake. Here we divided into three parties. Prof. Willmott and Mr. George went east by rail to White river and pushed south by Dog river to lake Superior over unmapped territory which they surveyed with micrometer and compass. Mr. Coulthard with Sayers went south to examine Caribou island, and I crossed unexplored territory from Bremner on the railway to the mouth of Pucaswa river on lake Superior, making a track survey. The Caribou picked up Prof. Willmott and myself and took us to Michipicoton island, where copper deposits were examined ; and then to Michipicoton Post, the gateway to the new gold mining district, which we visited. Here the Caribou was dismissed and we finished our travel by steamer Telegram.

During the summer, as directed by Mr. Blue, we visited all the water falls possible, and determined their height and the volume of water at the time in order to obtain materials for a report on the numerous and important water powers of the region.

After revisiting the Huronian tract east of the "Soo" we returned via Owen Sound

[illegible]

[illegible] many of which still retained the

Geology of Canada, [illegible], pp. 55-63

Geol. Sur. Can., 1857, [illegible] etc., [illegible] e stone displays variously banded sur- f pale gray, and would probably be me when polished. The quarry had ɪened up to a considerable extent, and a ing machine put at work, but appar- rithout being satisfactory, as it has ɪandoned and the rails removed from ɪr of track. Further mention will be f this limestone in the portion of the dealing with the Huronian question.

railway has opened a gravel pit in ld beach deposits east of the quarry, g a face of about 20 feet. The mate- ɪtained are used in filling a long trestle nouth of Echo river a few miles to ɪt. Much higher terraces of drift ɪls are found up the valley of Garden but these will be discussed under the : pleistocene geology.

Victoria and Cascade Mines.

xcursion was made under the guidance ɪrge Kabaoosa to the Victoria mine of the Indian reserve, passing wide ɔovered terraces between rocky walls scended the river valley. We were by the rich forest with its splendid along the way, the only unpleasant being the number of tent-caterpillars ɪttacked the leaves and dropped upon ɪsers beneath. The road was fairly ɪp to lake Ann, being used to this by lumbermen. The damming and of the lake here cuts it off, and the 'o or three of the nine miles to the re in very bad repair. Beyond lake e found a few outcrops of Laurentian- ; gniess with dikes of granite rising h the drift, but at the Victoria lake he mine rock looking like Huronian itself again as greenstone and chloritic ɪer schists broken by some small granite nd apparently inclosed in granite or The two lakes are small, really only and the stream connecting them and ; to Garden river is unimportant.

ictoria mine there are numerous build- ɔoarding house, shaft house, mill, assay office, dwellings, stable, etc., with a tramway to the dump. The mill spectable size, but no machinery is to be seen except tanks, jigs, etc., for concentrating the ore, apparently little used. The large dump consists chiefly of chlorite schist with some quartz. There are at the mill a number of barrels of galena in small lumps and some powdered ore of the same kind. Associated with the galena one finds some dark zincblende and copper and iron pyrites as well as quartz. This mine was visited in 1876 by Dr. Bell, who describes two veins as being worked at the time, one of solid galena only three inches across at the surface but widening to nineteen at the bottom of a shaft fifteen feet deep. A sample of galena taken from the ore pile yielded 168 oz. of silver per ton of 2,000 lb. when assayed by Dr. Harrington. Two other samples however taken by Dr. Bell himself from the veins assayed only 12 and 2 oz. per ton.[3] An assay in the laboratory of the School of Science, Toronto, gave 3 oz, 16 dwt. per ton.

Cascade Mine.

Three-fourths of a mile farther up stream, along a good road paved with tailings, is the Cascade mine, with similar ore with the addition of calcite. The rock dump is large, and consists mostly of soft green chloritic schist with dike material of red granite and some greenstone breccia. The ore in both mines seems to occur in irregular veins in large dikes or masses of sheared and weathered diabase. The Cascade mine is provided with a mill, shafthouse, engine house for a compressor and dwelling houses. A dam provides water which falls at the "cascade" about 50 feet, though the stream is of small volume. An assay of the galena yielded 9 oz. 16 dwt. of silver per ton.

Though there are no settlers in the valley, perhaps because the lower end of it is included in the Indian reserve, there is a considerable area of very fair land to be seen on the road to these mines.

Echo Lake Region.

A Plague of Tent Caterpillars.

Proceeding down the stream from Garden river we stopped first to examine a high projecting hill of altered diabase a mile to the north of Great Lake George, probably a mass erupted through the Huronian, now standing out because of its greater power of resistance to erosion. Along this part of the shores the poplars and to a less extent other trees were stripped of leaves by a plague of tent caterpillars. Even ferns and alders were somewhat attacked, and one could hardly step on the rocks without crushing the creatures. Some of the woods looked as bear as if swept by fire.

---

[3] Geol. Sur. Can. 1876-77, pp. 212-13.

Echo River and Echo Lake.

Echo river opens into wide shallow flats with marshy borders and Great Lake George is very shallow itself, the steamboat channel requiring to be dredged almost the whole length of the lake. Entering the river one sees white hills of Huronian quartzite on the east shore, with cultivated farms in the valleys. The river winds towards the northeast for three or four miles through alluvial plains until beautiful Echo lake with its mountainous shores opens out. Just where the lake enters the river there is considerable clearing at the foot of a mountain, and a farm house with a garden full of bloom, an unexpected sight in this somewhat wild region. The shores of Echo lake present excellent exposures of the Huronian, as noted by Murray in 1857. The limestone band seen at Garden River shows as two promontories on the lake, and has the same character as at the former point.

Austin Copper Mine.

A good road leads a mile northwest to the buildings of the Austin copper mine, and a poorer road goes some distance farther to the shafts which are high up on a hill. In addition to the shafts a tunnel has been driven into the hill, which consists of Logan's "slate conglomerate," a graywacke containing a few pebbles. The ore on the dump is white quartz with some copper pyrites and a carbonate like ankerite. The mine has not been worked for years.

Trout and Iron Lakes.

An excursion was made to Trout and Iron lakes, north of Echo lake, going up the river a mile and a half, as far as there was good navigation, and then walking inland by old lumber roads. Trout lake is about three miles from the landing place and 350 feet above Echo lake, which is a few feet higher than lake Huron. The lake is very pretty, with high rocky shores to the north, partly of handsome jasper conglomerate. This outcrop of red jasper co erate is not noted on Murray's geo map of the Huronian region, but was by Prof. Willmott ten years ago. Iro lies two or three miles northwest of lake, is about a third of a mile long a feet (aneroid) above lake Huron. outlet a creek flows swiftly down thro rock wall ravine to join Trout creek. trout are said to inhabit all these water saw no trace of iron on the lake, but another outcrop of jasper conglomerat most striking of the Huronian rocks. region was visited in 1876 by Messrs. and Frank Adams, then Dr. Bell's assis but they took a course different fron and saw no jasper conglomerate, only rocks, quartz, etc.[4]

Bruce Mines Region.

Bruce Mines to Rock Lake.

Leaving Echo lake we made a hard pull against headwinds down Great George and the North Chan Bruce Mines. Along the lake are very few outcrops of rock many along the shores of the channel ious rocks of the Huronian on the nort and of Cambrian and Lower Silurian south. On June 18 we drove out to the Lake copper mine and the Ophir gold passing Ottertail and Rock lakes, by showing great variety of geological int As far as Ottertail it runs over stiff gray evidently a lake silt, with exposures of conglomerate and other Huronian along the way. The farm land seems s if rather heavy, to this point. Beyon country grows more mountainous an valleys and plains more sandy as the works upward on a series of lofty terraces, the highest 470 feet (aneroid) lake Huron or more than 1,040 feet the sea.

Rock Lake Copper and Ophir Gold Mine.

The Rock Lake copper mine is really a prospect, no mining having been don is on Sandy McCloud's land the deposit extends to the boring farm on the south. country rock is chloritic slate with red q ite just to the south, and the ore bodie very irregular veins or lenses of quartz running partly parallel to the strike, partly across it. The widest part measures about 12 feet with some decayed rock included, but has no definite walls. The ore is copper pyrites with a little ankerite in quartz. Rusty places with more or less copper ore are seen at other points. A tunnel has been started on the lot to the south to tap one such ore body, but had not reached it at the time of our visit. So little work had been done on the property that no certain idea could be formed as to the quantity of ore likely to be found.

---

[4] Geol. Sur. Can. 1876-77. pp. 210-11.

Everything was shut down at the Ophir mine, and as it has been pretty fully described by Mr. Blue, who visited it while work was going on in 1893,[5] it will be unnecessary to give any account of it here.

Bruce and Wellington Copper Mines.

The old Bruce copper mine, with its long and irregular open cut running about N. 20 W., now a yawning chasm partly filled with water, has also been described by Mr. Blue[6]; and as it has long been abandoned nothing further need be said of it. We found, however, that the Wellington mine, a mile and a half northwest on the same vein or a parallel one, was being pumped out by Captain Thomas Trethewey as superintendent for Lord Douglas of Hawick, who represents a London syndicate. We went down the Scott shaft 180 feet to the third level. The fourth level had not yet been pumped out. The veins are nearly vertical, with a width of about eight feet. The walls are sometimes distinct and slickensided, sometimes quite irregular. We found more or less copper pyrites in the quartz on the levels, and [illegible] an open cut, but had no time or opportunity to explore the [illegible]. Captain Trethewey says that the lodes are faulted by three dikes.

A new [illegible] between the Wellington and Bruce [illegible] and quartz very [illegible] be seen. It was Captain Trethewey [illegible] that although [illegible] the vein or system of veins could ultimately be followed all the way from the Copper Bay location to the southeast end of the Bruce, a distance of 7,800 feet. As the old plans of the mine had been lost, fresh ones were in course of preparation. We were rather surprised to be taken to the gaol to see them. It seems that Bruce Mines is so law abiding that the lock-up has not had a prisoner for five years, so that the mine captain was allowed to set up his drafting tables there.

On our return journey early in August, we found that Professor Hatch of London was sampling the mine with a view to reporting upon it for Old World capitalists.

Trap Rock for Road Metal.

Although mining was at a standstill the village of Bruce Mines seemed fairly prosperous, largely, no doubt, because of the farming community growing up about it, more extensive and important than the traveller passing by rail or steam would suppose. Another industry of importance is the quarrying of "trap" as road metal.

Road making Material for Cleveland

This is carried on by the Spence Brothers of Cleveland, Ohio, who ship their product to that city for use in making its famous park roads. The firm had 42 men at work in the quarry at the [illegible] east end of the Bruce mine, and were [illegible] beginning operations for the season. They employed 65 men the previous year. In [illegible] half-inch of trap dust, which is wet down and rolled till water stands on top and hoofs leave no impress. Twenty-ton rollers are used for the work, which costs at present $2 per square yard. The cost was formerly $3.50.

---

[5] Third Rep. Bur. Mines, pp. [illegible]

[6] Third Rep. Bur. Mines, pp. [illegible]

The trap is a greenish-gray medium-grained diabase, which forms the country rock of the copper veins of the region, and is present in inexhaustible quantities. Some small quartz veins occur in the rock quarried, but the quartz is picked out and rejected.

This mass of diabase, included by Murray in the "lower slate conglomerate," is evidently of later age than the Huronian, since at more than one point to the east of the harbor it may be seen penetrating eruptively the red quartzite.

Other Excursions.

Bruce Mines to Thessalon.

After examining the shore as far as Thessalon and studying the contact of Laurentian and Huronian four miles beyond on the small islands scattered along the shore and also on the railway, we returned to Sault Ste. Marie. The results of this study will be given in another part of this report. Visits to a copper mine and also a supposed placer gold mine north of Thessalon were postponed till our return journey, when it was expected that the placer would be in operation.

Wash-out on an old Lake Terrace

Before leaving the "Soo" an excursion was made some miles northeast to examine the Laurentian-Huronian contact at a fresh point, and a brief survey was made of an extraordinary wash-out in an old lake terrace on section 9, two miles south of the boundary of Tarentorus township. Springs have undermined the drift materials and carved in three years a V-shaped ravine nearly 300 feet in length and 110 feet in depth at its outlet. It is said that most of the work was done in a single year. The road was destroyed and had to be shifted 100 yards to the west, and Silver creek, flowing in the valley below, was forced a long distance to the east by the debris which filled its valley, so that it now flows among the trees in the woods.

Northeast Shore of Lake Superior.

Literature of the Region.

On arrival at the Sault all arrangements were made for the Lake Superior trip, which began on June 22. The shore has been visited at various points by a number of geologists, especially at the copper deposits near Mamainse and on Michipicoton island, in regard to which there is a considerable literature, mostly of scattered papers and mine reports. An outline of the history has been given by Mr. Blue, who visited the region in 1893; and his report quotes the opinions of the more prominent geologists who have examined the copper mines.[7] The general geology of the region has been sketched by Sir William Logan in the Geology of Canada,[8] and Dr. Bell traversed the shore in 1876,[9] from Batchawana bay to Michipicoton river.

St. Mary's Sandstone.

Along St. Mary's river and for varying distances inland one sees only the St. Mary's sandstone where the solid rock is not covered with thick lake deposits forming a succession of terraces. The sandstone is red or green or pale gray or mottled, and has some shaly layers. It is best seen along the banks of the Canadian and American ship canals, where it is often beautifully ripple-marked and cross-bedded, being evidently a shallow water formation. As no fossils have been found with certainty in it the age has not been positively determined. Logan thinks it of Chazy or Cambro-silurian age;[10] but others place it in the Potsdam or Upper Cambrian. As noted by Logan, these sandstones lie nearly horizontal, unlike the other and older rocks of the region, which are usually tilted more or less steeply; and the country which these soft rocks underlie is usually flat and low, differing greatly from the parts formed of Huronian and Laurentian rocks. This sandstone is to some extent available for building purposes, though rather soft and fragile, as well as too much inclined to cleave into blocks of unmanageable shapes, to be considered a good building stone.

Great Gros Cap.

Following up the shore, Gros Cap, where the sandstones end and rocks mapped as Laurentian begin, is the first point of interest. The cape rises in a mountainous way with sheer cliffs towards the west, and is a very striking feature. There is a small landing on the southeast side of the point for fishing boats, and a sawmill with a few settlers' houses are scattered along the low sandy shore to the east. In the rear of the little settlement two old lake terraces rise, one 56 feet, the other 224 feet, above lake Superior.

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[7] Bur. Mines, 1893, pp. 63-88.

[8] Geol. Can., 1863, pp. 70-86, also p. 699, etc.

[9] Geol. Sur. Can., 1876-7, p. 213, etc.

[10] Geol. Can., 1863, p. 86.

The rock at the point of Great Gros Cap is red porphyry, containing a few fragments of rather coarse quartzite, so that it is no doubt later than Huronian, but just around the point one finds a few hundred yards of diabase and then Laurentian granite or gneiss. At various points beyond amygdaloidal diabase (or melaphyre) and red quartzless porphyry occur in small patches, and with them veins of calcite and a red material like the vein matter associated with the lake Superior copper ores ; so that the projecting points of the coast consist of the Keweenawan or Upper Copper-bearing series, while the interior is Laurentian. The latter shows much variety, including greenstones and hornblende schist very like the Keewatin of Rainy lake, red granite, syenite and gneiss.

Goulais river Valley.

After rounding the point a thin strip of the St. Mary's sandstone extends along shore to the mouth of Goulais bay, after which the shore is again formed of Archæan rocks. We attempted to enter the mouth of Goulais river so as to anchor there and explore it, but found a bar stretching across its mouth giving too little water for our craft, which drew about 2½ feet. Later in the summer Prof. Willmott and I drove out to the river from the Sault and examined parts of the valley and surrounding mountains. As the first rapid is 30 miles up Goulais river, which winds through alluvial flats in the lower part of its course, we were unable to carry out our instructions regarding the examination of water powers without spending more time than could be spared. There are said to be three high falls about 40 miles up, and as there is a considerable volume of water these may in the future furnish valuable power.

The point on the west of Goulais bay, where the mission and a small fishing station are placed, consists of St. Mary's sandstone, and the same flat lying rock forms the shore until the mouth of Batchawana bay, the next inlet to the north.

Batchawana Bay.

The Bay and its Name.

The name of this bay is spelled variously by different authorities. Logan's map makes it Batchehwahnung, the British Admiralty chart of lake Superior spells it Bachewanaung, and the United States chart follows its precedent. The map issued by the Crown Lands Department of Ontario gives it the form Batchawaung ; and the people of the region generally call the bay Batchawana. The last form is easily spelled and pronounced and, as it is rather euphonious, should perhaps be preferred.

The bay has a very interesting shore line, rising to low mountains towards the south east, east and north, and presents fine outcrops of Laurentian, Huronian and St. Mary's sandstone the latter mainly at its outlet and on a large island which stretches more than half way across the entrance. As usual, the Cambrian sandstone lies nearly horizontally and forms the low ground, while the harder and more ancient rocks rise steeply as hills, at one point on the east to a height of 690 feet as determined by aneroid.

Geology of the Bay.

Small bands of Keweenawan or Upper Copper-bearing rock come out on the east shore, as mentioned by Logan, though not so mapped. There are small outcrops of red quartzless porphyry and larger ones of amygdaloid, the latter forming a row of hills running about east and west at the northeast corner of the bay. The rocks just referred to are very much like the Keweenawan farther west.

Professor Willmott gives the following account of the geology of the southern portion of the bay :

"The south-eastern shore of Batchawana Bay consists of slate conglomerate holding boulders of coarse-grained red granite. A band of red, porphyritic, granitoid gneiss cuts through the slate, appearing on a point on the west shore and on a point of the opposite shore a mile to the east. This gneiss, which is in eruptive contact with the slate, in one place loses its porphyritic character near the slate and then assumes it suddenly a few yards away. A few hundred feet from this point the gneiss was observed to hold sharp angular inclusions of basic schists closely resembling the Keewatin contacts of the Lake of the Woods. On the eastern point the gneiss was in places quite dark in color."

Chippewa River.

The Chippewa river entering Batchawana bay on the north has a splendid fall of over 80 feet about a mile from its mouth. Above this there is said to be good navigation for a long distance. The portage past the fall is about three-fourths of a mile and is rough in places.

Batchawana River.

The Batchawana river also was visited and ascended about six miles, mostly against a swift current. At five and a half miles up there is a rapid too heavy to pole up, so the canoe was taken no farther. No falls of importance were met with in the distance traversed, and few outcrops of rock occur, all that were observed having the look of Laurentian. The shores are often steep cut banks of sand and gravel, with a little stratified clay at bottom, and form well-marked terraces.

The northeastern part of the bay is almost cut off from the western part by the large island mentioned before and a long sandy point projecting southwards. As we approached the latter a group of sleek lumbermen's horses was collected at the point where the wind swept strongest, so as to avoid the flies, which were very tormenting in the bush at the time.

Prof. Willmott describes the Carp river as follows :

Carp River.

"The Carp is a small stream flowing into the north side of Batchawana bay. For the last mile it flows through a sand and gravel plain in a rapid and tortuous course. All obstructions have been removed by the company cutting pulpwood on its bank, so that it is navigable down stream. The banks are often fifty feet high, and in places stratified clay is seen as well as sand and gravel. Beyond the pulpwood camp, one mile inland, the stream is a succession of falls. Two miles and a half from the mouth the bed is 250 feet above S
At this point the rock is gneiss, but c
at once to the south into a band of a
loid striking east. Three-quarters of
farther down the stream a conglomer
against the latter which are both doub
Keweenaw age."

Corby Point.

There is a steamboat landing and
station on the east side of the poin
protects the bay from the pr
west winds; and a lig
stands a mile or two south on Corbea
The village is not a savory one, since t
of the fish taken is dumped not far of
ing a perpetual attraction to gulls and
and the idle horses of the lumberme
the point at will. Lumbering will soo
in this region, the pine having been r
as well as much of the spruce, balsa
cedar. The material left is mostly v
as pulpwood, of which we saw large
ties in the more inland parts.

The Mamainse Region.

Roussain's Station.

Rounding Corbeau point we found to
wind to coast with canoes and sailed s
to Roussain's fishing station,
there is a small snug harbo
tiny settlement. The shore here is b
very rugged, consisting of black e
rock in thick layers, separated by l
amygdaloid and conglomerate. As th
rocks are soft and easily attacked by
they wear away along the shore, leavi
harder eruptive masses standing a
stacks and islands. Many small ca
eaten by the waves in the softer roc
harder layers roofing them over.

Mamainse Harbor.

The next point stopped at was Ma
harbor, where narrow channels betwee
islands and the shore make
harbor. Sand bay, where t
of the same name is located, is a mile
south, but affords little shelter for
The mine is not working, being left in
of a caretaker who served us as guide
the different pits and shafts. As th
has been described by Mr. Blue,[11] litt
be said of it here. A mile north of t

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[11] Bur. Mines, 1893, p. 66, etc. Refere
the literature are given here.

at a small costean pit, there is a plate of native copper eighteen inches long by an inch in thichness standing up from the decayed amygdaloids. This and the pile of ore rich in native copper at the main shaft give evidence that the metal is present in considerable amounts.

Mamainse Copper Mine.

About two miles north of Mamainse harbor is the old Mamainse copper mine, worked, it is said, 46 years ago, and again 17 years ago, where a village of 30 houses without an inhabitant may be seen. The houses have stone foundations and are well constructed frame buildings in a fair state of preservation except for doors and windows, all of which have been carried off. There is a church, two shaft houses, and a large mill containing crushing and concentrating appliances. There is very little ore to be seen on the dumps, which evidently consist of waste rock, mainly amygdaloids. The site is an attractive one, but with a very poor harbor. Rugged strips of black amygdaloid and trap run out into the lake with curving beaches of well-rolled pebbles between. The village stands on a low terrace, with wild flowers, red and white clover and wild strawberries all about, and a pretty stream flowing into the lake.

Pointe aux Mines.

Geology of the Point.

Beyond Mamainse rocks apparently of Laurentian and Huronian age show themselves, red granite and gneiss penetrated by dark green dikes and also great masses and dikes of a very coarse grained pegmatite or giant granite, having flesh red felspars as large as one's hand embedded in a coarse grained granite ground mass. Here and there are strips and masses of Keweenaw rocks leaning up against them, often with a basal conglomerate or breccia of gneiss and granite at the bottom. A few beds of brown shale and sandstone, probably Cambrian, occur at the foot of bays.

Pointe aux Mines from the south seems to be a mixture of Laurentian and Keewatin rocks, but to the north shows amygdaloids and conglomerate having the usual rugged shore formed by Keweenawan rocks. The mine is a few hundred yards inland from the landing place in a bay north of the point. On the hill side there are the ruins of two or three buildings with massive stone foundations, and the opening of a tunnel with its timbers all rotten and falling in. There are several deep pits farther up the hill and several heaps of rock from the excavations, with little amygdaloid and no conglomerate to be seen. There are also two heaps of slag containing a number of tons resulting from smelting operations. An assay of this slag gave 1.20 per cent. of copper. This mine is reported to have been worked 46 years ago, and is said to have been attacked by Indians. For its defence two cannon and a body of militia were brought up, according to Sayers, the captain of our fishing boat.

Ruins of the old Mine.

There are several heavy square iron stamps on the beach, perhaps landed but not put in place at the mill. In all there must have been a large amount of work done at this mine, but there is now very little ore to be seen, perhaps because all that was obtained had been smelted. Young trees are now growing among the ruins of the buildings, and from the shore there is nothing but woods to be seen.[12]

Features of the Coast Line.

To the north of Pointe aux Mines in a large bay flat lying sandstones, like those of the last bay, probably St. Mary's sandstones, cover a wide area beneath the shallow water and appear to slope off towards the open lake. The points however are of Laurentian, containing fewer Keewatin inclusions than farther south. The scenery is magnificent, granite cliffs rising 500 feet above the lake. A curious cave shows at the northern point of the bay and two others at 30 and 50 feet above the water, probably old shore caves. Here small patches of conglomerate with gniess and granite pebbles lean against the granite and are with difficulty distinguished from it. Old chasms in the Laurentian are filled with this rock, proving that an old shore stood just at the level of the present shore and presenting the same conditions. This conglomerate is probably Keweenawan. As the cement is soft it easily weathers out and sets free the

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Cf. Macfarlane, Geol. Sur. Can., 1863-66, p. 144.

COPPER REGIONS OF THE UPPER LAKES.

By Dr. A. P. Coleman.

Introduction.

dance with the instructions of Mr.
ald Blue, Director of the Bureau of
st summer's work was devoted to
ation of the rocks on the north
t the northwest end of lake Huron,
e northeast shore of lake Superior,
ial reference to the copper deposits
on. Professor Arthur B. Willmott,
ter University, was once more appointed assistant geologist and proved as helpful and efficient as on former occasions. Messrs. R.
hard and R D. George, B.A., were
junior assistants and rendered
ervice during the summer's work.
s of travel were more varied than
ng to the different type of country
we were employed, part of it more
tled, with backwoods roads passable
eeled vehicles, and another part
being traversed only with canoes ;
main portion of our travel along
y shore of lake Superior was per-
a Collingwood skiff manned by
l French-speaking fishermen from
Marie, Edward Sayers serving as
d Stephen Jollineau as seaman and
th did their work satisfactorily.
, the Caribou, carried only two fore
ils and had very little accommoda-
r the deck covering the bow, so that
camp at night at some harbor or
he was safe as handled by Sayers
d a good sailor, but very heavy to
h occasionally cost us much time
. Travelling by canoe or row boat
advantages, but on so large a lake
or one runs a certain risk in a small
may lose days in succession by high
ortunately there are innumerable
ors on the wild and rocky north shore of the lake, so that a fishing boat seldom requires to go more than a few miles to find shelter.

General Scope of the Season's Work.

We left Toronto on June 7th and proceeded by way of Collingwood to Sault Ste. Marie. A canoe trip was made down the St. Mary's river as far as Thessalon to examine the rocks of the Huronian as originally defined by Logan, and to visit the copper deposit at Bruce Mines and other points. We then cruised from the "Soo" along the northeast shore of lake Superior, coasting with canoes as much as the weather permitted, and visiting the copper mines near Mamainse. This trip ended at Heron bay, where the Canadian Pacific railway first touches the lake. Here we divided into three parties. Prof. Willmott and Mr. George went east by rail to White river and pushed south by Dog river to lake Superior over unmapped territory which they surveyed with micrometer and compass. Mr. Coulthard with Sayers went south to examine Caribou island, and I crossed unexplored territory from Bremner on the railway to the mouth of Pucaswa river on lake Superior, making a track survey. The Caribou picked up Prof. Willmott and myself and took us to Michipicoton island, where copper deposits were examined ; and then to Michipicoton Post, the gateway to the new gold mining district, which we visited. Here the Caribou was dismissed and we finished our travel by steamer Telegram.

During the summer, as directed by Mr. Blue, we visited all the water falls possible, and determined their height and the volume of water at the time in order to obtain materials for a report on the numerous and important water powers of the region.

After revisiting the Huronian tract east of the "Soo" we returned via Owen Sound and reached Toronto on August 14. As on former occasions, my acknowledgments are due to many mining men and others interested in the development of the region for valuable assistance and for ready hospitality. The maps and reports of the Geological Survey of Canada were of course of the utmost value to us in carrying on our work. The old map of the Huronian region, prepared to accompany Logan's geology of Canada in 1863, is still the only geological map available for the study of the region just east and just north of the St. Mary's river; and was found to be very accurate as far as we covered the ground, though on too small a scale to permit of very minute mapping.

The Blue Mountains.

A Topographical Feature of Simcoe County.

Desiring to examine the Blue Mountains and the old beaches on their flanks, Prof. Willmott and I left Toronto for Collingwood a day earlier than was necessary to catch our steamer, and drove out to the nearest part of the long escarpment which stretches across the southwestern peninsula of Ontario and is known everywhere from Hamilton to Georgian bay as "the Mountain." It is really of course the edge of a tableland capped by the resistant Niagara limestones, the softer shales to the east having been more rapidly denuded by the action of frost and water, leaving the limestone-covered portion to rise as more or less prominent cliffs. Between Collingwood and the foot of the Blue mountains the land is almost a plain, sometimes boulder covered, with a series of gentle steps, probably representing old shore lines, up to 207 feet (aneroid); above which there is a steep ascent over grassy or wooded slopes, mainly of reddish and greenish Medina shale. There appear to be beach lines also at 288 and at 468 feet above the bay as shown by aneroid, and probably also at 940 feet.

The top of the escarpment is of thickly bedded limestone of a creamy color, forming perpendicular and often unscaleable walls, with a talus of rough, frost-quarried blocks at the base. This cliff is divided into pillars and bastion-like projections by profound fissures, many of which still retained the winter's snow on the hot day of ea
when we visited the spot.

The rock is burned for lime, and,
mand, would make a handsome
stone, which could be furnished in l
almost any dimensions required.

A few hours stay in Owen Sound
ized in examining the drift terraces in
of the town. Clays making red b
white pottery occur here.

St. Mary's River and the North C

The original Huronian Country and its Minerals.

On June 10th we reached Sault Ste
our starting point for a study of the
Huronian as described by
liam Logan, and his a
Alexander Murray, whose w
gives the most complete account of t
teresting rocks and is referred to i
text book of geology. A good sum
their results is given in the 1863
while Murray's more extended earlie
are now hard to get.[2]

On June 11th we set out by can
the St. Mary's river, halting for the
Garden River, where interesting e
of the original Huronian rocks are to
The channel we followed is now
deserted by steamboat traffic since th
ing of the shorter and straighter
the American side. Only a few lo
now ply here, and the villages and
often have rather a deserted look.

Garden River Marble Quarry.

The village of Garden River was
important lumber centre, but has fall
since the mills were burned some ti
There is a reserve at the mouth of t
with an Indian village and a missio
the charge of the English Church
village is on a very pretty sandy po
two or three miles inland rocky hills
high enough to be called mountains,
steep flanks and more or less rounded
summits. Some years ago a marbl
was opened on a band of Huronian li
not far from the village, a switch bei
ried north from the railway to give

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[1] Geology of Canada, 1863, pp. 55-63.

[2] Geol. Sur. Can., 1857, p. 18, etc., a

it. The stone displays variously banded surfaces of pale gray, and would probably be handsome when polished. The quarry had been opened up to a considerable extent, and a chanelling machine put at work, but apparently without being satisfactory, as it has been abandoned and the rails removed from the spur of track. Further mention will be made of this limestone in the portion of the report dealing with the Huronian question.

The railway has opened a gravel pit in some old beach deposits east of the quarry, showing a face of about 20 feet. The materials obtained are used in filling a long trestle at the mouth of Echo river a few miles to the east. Much higher terraces of drift materials are found up the valley of Garden river, but these will be discussed under the head of pleistocene geology.

Victoria and Cascade Mines.

An excursion was made under the guidance of George Kabaoosa to the Victoria mine north of the Indian reserve, passing wide forest-covered terraces between rocky walls as we ascended the river valley. We were struck by the rich forest with its splendid maples along the way, the only unpleasant feature being the number of tent-caterpillars which attacked the leaves and dropped upon the passers beneath. The road was fairly good up to lake Ann, being used to this point by lumbermen. The damming and raising of the lake here cuts it off, and the last two or three of the nine miles to the mine are in very bad repair. Beyond lake Ann we found a few outcrops of Laurentian-looking gniess with dikes of granite rising through the drift, but at the Victoria lake near the mine rock looking like Huronian shows itself again as greenstone and chloritic and other schists broken by some small granite dikes and apparently inclosed in granite or gneiss. The two lakes are small, really only ponds, and the stream connecting them and flowing to Garden river is unimportant.

Victoria Mine.

At Victoria mine there are numerous buildings, a boarding house, shaft house, mill, assay office, dwellings, stable, etc., with a tramway to the dump. The mill is of respectable size, but no machinery is to be seen except tanks, jigs, etc., for concentrating the ore, apparently little used. The large dump consists chiefly of chlorite schist with some quartz. There are at the mill a number of barrels of galena in small lumps and some powdered ore of the same kind. Associated with the galena one finds some dark zincblende and copper and iron pyrites as well as quartz. This mine was visited in 1876 by Dr. Bell, who describes two veins as being worked at the time, one of solid galena only three inches across at the surface but widening to nineteen at the bottom of a shaft fifteen feet deep. A sample of galena taken from the ore pile yielded 168 oz. of silver per ton of 2,000 lb. when assayed by Dr. Harrington. Two other samples however taken by Dr. Bell himself from the veins assayed only 12 and 2 oz. per ton.[3] An assay in the laboratory of the School of Science, Toronto, gave 3 oz. 16 dwt. per ton.

Cascade Mine.

Three-fourths of a mile farther up stream, along a good road paved with tailings, is the Cascade mine, with similar ore with the addition of calcite. The rock dump is large, and consists mostly of soft green chloritic schist with dike material of red granite and some greenstone breccia. The ore in both mines seems to occur in irregular veins in large dikes or masses of sheared and weathered diabase. The Cascade mine is provided with a mill, shafthouse, engine house for a compressor and dwelling houses. A dam provides water which falls at the "cascade" about 50 feet, though the stream is of small volume. An assay of the galena yielded 9 oz. 16 dwt. of silver per ton.

Though there are no settlers in the valley, perhaps because the lower end of it is included in the Indian reserve, there is a considerable area of very fair land to be seen on the road to these mines.

Echo Lake Region.

A Plague of Tent Caterpillars

Proceeding down the stream from Garden river we stopped first to examine a high projecting hill of altered diabase a mile to the north of Great Lake George, probably a mass erupted through the Huronian, now standing out because of its greater power of resistance to erosion. Along this part of the shores the poplars and to a less extent other trees were stripped of leaves by a plague of tent caterpillars. Even ferns and alders were somewhat attacked, and one could hardly step on the rocks without crushing the creatures. Some of the woods looked as bear as if swept by fire.

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[3] Geol. Sur. Can. 1876-77, pp. 212-13.

Echo River and Echo Lake.

Echo river opens into wide shallow flats with marshy borders and Great Lake George is very shallow itself, the steamboat channel requiring to be dredged almost the whole length of the lake. Entering the river one sees white hills of Huronian quartzite on the east shore, with cultivated farms in the valleys. The river winds towards the northeast for three or four miles through alluvial plains until beautiful Echo lake with its mountainous shores opens out. Just where the lake enters the river there is considerable clearing at the foot of a mountain, and a farm house with a garden full of bloom, an unexpected sight in this somewhat wild region. The shores of Echo lake present excellent exposures of the Huronian, as noted by Murray in 1857. The limestone band seen at Garden River shows as two promontories on the lake, and has the same character as at the former point.

Austin Copper Mine.

A good road leads a mile northwest to the buildings of the Austin copper mine, and a poorer road goes some distance farther to the shafts which are high up on a hill. In addition to the shafts a tunnel has been driven into the hill, which consists of Logan's "slate conglomerate," a graywacke containing a few pebbles. The ore on the dump is white quartz with some copper pyrites and a carbonate like ankerite. The mine has not been worked for years.

Trout and Iron Lakes.

An excursion was made to Trout and Iron lakes, north of Echo lake, going up the river a mile and a half, as far as there was good navigation, and then walking inland by old lumber roads. Trout lake is about three miles from the landing place and 350 feet above Echo lake, which is a few feet higher than lake Huron. The lake is very pretty, with high rocky shores to the north, partly of handsome jasper conglomerate. This outcrop of red jasper co
erate is not noted on Murray's geo
map of the Huronian region, but was
by Prof. Willmott ten years ago. Iro
lies two or three miles northwest of
lake, is about a third of a mile long a
feet (aneroid) above lake Huron.
outlet a creek flows swiftly down thro
rock wall ravine to join Trout creek.
trout are said to inhabit all these water
saw no trace of iron on the lake, but
another outcrop of jasper conglomerat
most striking of the Huronian rocks.
region was visited in 1876 by Messrs.
and Frank Adams, then Dr. Bell's assis
but they took a course different fro
and saw no jasper conglomerate, only
rocks, quartz, etc.[4]

Bruce Mines Region.

Bruce Mines to Rock Lake.

Leaving Echo lake we made a hard
pull against headwinds down Great
George and the North Chan
Bruce Mines. Along the lake
are very few outcrops of rock
many along the shores of the channel
ious rocks of the Huronian on the nort
and of Cambrian and Lower Silurian
south. On June 18 we drove out to the
Lake copper mine and the Ophir gold
passing Ottertail and Rock lakes, by
showing great variety of geological int
As far as Ottertail it runs over stiff gray
evidently a lake silt, with exposures of
conglomerate and other Huronian
along the way. The farm land seems s
if rather heavy, to this point. Beyon
country grows more mountainous an
valleys and plains more sandy as the
works upward on a series of lofty
terraces, the highest 470 feet (aneroid)
lake Huron or more than 1,040 feet
the sea.

Rock Lake Copper and Ophir Gold Mine.

The Rock Lake copper mine is really
a prospect, no mining having been don
is on Sandy McCloud's land
the deposit extends to the
boring farm on the south.
country rock is chloritic slate with red q
ite just to the south, and the ore bodie

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[4] Geol. Sur. Can. 1876-77. pp. 210-11.

very irregular veins or lenses of quartz running partly parallel to the strike, partly across it. The widest part measures about 12 feet with some decayed rock included, but has no definite walls. The ore is copper pyrites with a little ankerite in quartz. Rusty places with more or less copper ore are seen at other points. A tunnel has been started on the lot to the south to tap one such ore body, but had not reached it at the time of our visit. So little work had been done on the property that no certain idea could be formed as to the quantity of ore likely to be found.

Everything was shut down at the Ophir mine, and as it has been pretty fully described by Mr. Blue, who visited it while work was going on in 1893,[5] it will be unnecessary to give any account of it here.

Bruce and Wellington Copper Mines.

The old Bruce copper mine, with its long and irregular open cut running about N. 20° W., now a yawning chasm partly filled with water, has also been described by Mr. Blue[6]; and as it has long been abandoned nothing further need be said of it. We found, however, that the Wellington mine, a mile and a half northwest on the same vein or a parallel one, was being pumped out by Captain Thomas Trethewey as superintendent for Lord Douglas of Hawick, who represents a London syndicate. We went down the Scott shaft 180 feet to the third level. The fourth level had not yet been pumped out. The veins are nearly vertical, with a width of about eight feet. The walls are sometimes distinct and slickensided, sometimes quite irregular. We found more or less copper pyrites in the quartz on the levels, and also some rich ore in an open cut, but had no time nor opportunity to explore the mine thoroughly. Captain Trethewey says that the lodes are faulted by three dikes.

A new opening was being made on a vein between the Wellington and Bruce mines, and quartz very rich in copper pyrites was to be seen. It was Captain Trethewey's opinion that, although drift-covered at the surface, the vein or system of veins could ultimately be followed all the way from the Copper Bay location to the southeast end of the Bruce, a distance of 7,800 feet. As the old plans of the mine had been lost, fresh ones were in course of preparation. We were rather surprised to be taken to the gaol to see them. It seems that Bruce Mines is so law-abiding that the lock-up has not had a prisoner for five years, so that the mine captain was allowed to set up his drafting tables there.

On our return journey early in August, we found that Professor Hatch of London was sampling the mine with a view to reporting upon it for Old World capitalists.

Trap Rock for Road Metal.

Although mining was at a standstill the village of Bruce Mines seemed fairly prosperous, largely, no doubt, because of the farming community growing up about it, more extensive and important than the traveller passing by rail or steam would suppose. Another industry of importance is the quarrying of "trap" as road metal.

Road-making Material for Cleveland.

This is carried on by the Spence Brothers of Cleveland, Ohio, who ship their product to that city for use in making its famous park roads. The firm had 42 men at work in the quarry, at the south east end of the Bruce mine, and were just beginning operations for the summer. They employed 65 men the previous year. Dr. Spence, the member of the firm in charge of the quarry, gave me some information regarding the method in use in road making at Cleveland, for which and other courtesies I wish to express my thanks. As the method may be of interest to Canadian readers a brief account of it is given here.

As a foundation, [illegible]

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[5] Third Rep. Bur. Mines, pp. [illegible]-45.

[6] Third Rep. Bur. Mines, pp. [illegible]-37.

half-inch of trap dust, which is wet down and rolled till water stands on top and hoofs leave no impress. Twenty-ton rollers are used for the work, which costs at present $2 per square yard. The cost was formerly $3.50.

The trap is a greenish-gray medium-grained diabase, which forms the country rock of the copper veins of the region, and is present in inexhaustible quantities. Some small quartz veins occur in the rock quarried, but the quartz is picked out and rejected.

This mass of diabase, included by Murray in the "lower slate conglomerate," is evidently of later age than the Huronian, since at more than one point to the east of the harbor it may be seen penetrating eruptively the red quartzite.

Other Excursions.

Bruce Mines to Thessalon.

After examining the shore as far as Thessalon and studying the contact of Laurentian and Huronian four miles beyond on the small islands scattered along the shore and also on the railway, we returned to Sault Ste. Marie. The results of this study will be given in another part of this report. Visits to a copper mine and also a supposed placer gold mine north of Thessalon were postponed till our return journey, when it was expected that the placer would be in operation.

Wash-out on an old Lake Terrace

Before leaving the "Soo" an excursion was made some miles northeast to examine the Laurentian-Huronian contact at a fresh point, and a brief survey was made of an extraordinary wash-out in an old lake terrace on section 9, two miles south of the boundary of Tarentorus township. Springs have undermined the drift materials and carved in three years a V-shaped ravine nearly 300 feet in length and 110 feet in depth at its outlet. It is said that most of the work was done in a single year. The road was destroyed and had to be shifted 100 yards to the west, and Silver creek, flowing in the valley below, was forced a long distance to the east by the debris which filled its valley, so that it now flows among the trees in the woods.

Northeast Shore of Lake Superior.

On arrival at the Sault all arrangements were made for the Lake Superior trip, which

Literature of the Region.

began on June 22. The sho
been visited at various poin
a number of geologists, espe
at the copper deposits near Mamainse a
Michipicoton island, in regard to which
is a considerable literature, mostly o
tered papers and mine reports. An o
of the history has been given by Mr.
who visited the region in 1893 ; and h
port quotes the opinions of the more pr
ent geologists who have examined the c
mines.[7] The general geology of the r
has been sketched by Sir William Log
the Geology of Canada,[8] and Dr. Be
versed the shore in 1876,[9] from Batch
bay to Michipicoton river.

St. Mary's Sandstone.

Along St. Mary's river and for va
distances inland one sees only the St. M
sandstone where the solid r
not covered with thick lake de
forming a succession of terraces. The
stone is red or green or pale gray or m
and has some shaly layers. It is bes
along the banks of the Canadian and A
can ship canals, where it is often beau
ripple-marked and cross-bedded, bein
dently a shallow water formation.
fossils have been found with certaint
the age has not been positively detern
Logan thinks it of Chazy or Cambro-sil
age ;[10] but others place it in the Potsd
Upper Cambrian. As noted by Logan,
sandstones lie nearly horizontal, unli
other and older rocks of the region, whi
usually tilted more or less steeply ; a
country which these soft rocks und
usually flat and low, differing greatl
the parts formed of Huronian and Laur
rocks. This sandstone is to some
available for building purposes, though
soft and fragile, as well as too much in
to cleave into blocks of unmanageable s
to be considered a good building stone.

Great Gros Cap.

Following up the shore, Gros Cap,
the sandstones end and rocks map
Laurentian begin, is the first
of interest. The cape rises

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[7] Bur. Mines, 1893, pp. 63-88.

[8] Geol. Can., 1863, pp. 70-86, also p. 699,

[9] Geol. Sur. Can., 1876-7, p. 213, etc.

[10] Geol. Can., 1863, p. 86.

mountainous way with sheer cliffs towards the west, and is a very striking feature. There is a small landing on the southeast side of the point for fishing boats, and a sawmill with a few settlers' houses are scattered along the low sandy shore to the east. In the rear of the little settlement two old lake terraces rise, one 56 feet, the other 224 feet, above lake Superior.

The rock at the point of Great Gros Cap is red porphyry, containing a few fragments of rather coarse quartzite, so that it is no doubt later than Huronian, but just around the point one finds a few hundred yards of diabase and then Laurentian granite or gneiss. At various points beyond amygdaloidal diabase (or melaphyre) and red quartzless porphyry occur in small patches, and with them veins of calcite and a red material like the vein matter associated with the lake Superior copper ores ; so that the projecting points of the coast consist of the Keweenawan or Upper Copper-bearing series, while the interior is Laurentian. The latter shows much variety, including greenstones and hornblende schist very like the Keewatin of Rainy lake, red granite, syenite and gneiss.

Goulais river Valley.

After rounding the point a thin strip of the St. Mary's sandstone extends along shore to the mouth of Goulais bay, after which the shore is again formed of Archæan rocks. We attempted to enter the mouth of Goulais river so as to anchor there and explore it, but found a bar stretching across its mouth giving too little water for our craft, which drew about 2½ feet. Later in the summer Prof. Willmott and I drove out to the river from the Sault and examined parts of the valley and surrounding mountains. As the first rapid is 30 miles up Goulais river, which winds through alluvial flats in the lower part of its course, we were unable to carry out our instructions regarding the examination of water powers without spending more time than could be spared. There are said to be three high falls about 40 miles up, and as there is a considerable volume of water these may in the future furnish valuable power.

The point on the west of Goulais bay, where the mission and a small fishing station
are placed, consists of St. Mary's sa
and the same flat lying rock forms t
until the mouth of Batchawana bay,
inlet to the north.

Batchawana Bay.

The Bay and its Name.

The name of this bay is spelled
by different authorities. Logan's ma
it Batchehwahnung, the
Admiralty chart of lake
spells it Bachewanaung.
United States chart follows its pr
The map issued by the Crown Lands
ment of Ontario gives it the form
waung ; and the people of the regio
ally call the bay Batchawana. The l
is easily spelled and pronounced and,
rather euphonious, should perhaps
ferred.

The bay has a very interesting sho
rising to low mountains towards th
east, east and north, and presents fi
crops of Laurentian, Huronian a
Mary's sandstone the latter mainl
outlet and on a large island which st
more than half way across the entran
usual, the Cambrian sandstone lies
horizontally and forms the low ground
the harder and more ancient rocks rise
as hills, at one point on the east to a
of 690 feet as determined by aneroid.

Geology of the Bay.

Small bands of Keweenawan or
Copper-bearing rock come out on t
shore, as mentioned by
though not so mapped. Th
small outcrops of red quartzless po
and larger ones of amygdaloid, th
forming a row of hills running ab
and west at the northeast corner of t
The rocks just referred to are very m
the Keweenawan farther west.

Professor Willmott gives the f
account of the geology of the southe
tion of the bay :

"The south-eastern shore of Bat
Bay consists of slate conglomerate
boulders of coarse-grained red gran
band of red, porphyritic, granito
cuts through the slate, appearing o
on the west shore and on a point of t
site shore a mile to the east. This

which is in eruptive contact with the slate, in one place loses its porphyritic character near the slate and then assumes it suddenly a few yards away. A few hundred feet from this point the gneiss was observed to hold sharp angular inclusions of basic schists closely resembling the Keewatin contacts of the Lake of the Woods. On the eastern point the gneiss was in places quite dark in color."

Chippewa River.

The Chippewa river entering Batchawana bay on the north has a splendid fall of over 80 feet about a mile from its mouth. Above this there is said to be good navigation for a long distance. The portage past the fall is about three-fourths of a mile and is rough in places.

Batchawana River.

The Batchawana river also was visited and ascended about six miles, mostly against a swift current. At five and a half miles up there is a rapid too heavy to pole up, so the canoe was taken no farther. No falls of importance were met with in the distance traversed, and few outcrops of rock occur, all that were observed having the look of Laurentian. The shores are often steep cut banks of sand and gravel, with a little stratified clay at bottom, and form well-marked terraces.

The northeastern part of the bay is almost cut off from the western part by the large island mentioned before and a long sandy point projecting southwards. As we approached the latter a group of sleek lumbermen's horses was collected at the point where the wind swept strongest, so as to avoid the flies, which were very tormenting in the bush at the time.

Prof. Willmott describes the Carp river as follows:

Carp River.

"The Carp is a small stream flowing into the north side of Batchawana bay. For the last mile it flows through a sand and gravel plain in a rapid and tortuous course. All obstructions have been removed by the company cutting pulpwood on its bank, so that it is navigable down stream. The banks are often fifty feet high, and in places stratified clay is seen as well as sand and gravel. Beyond the pulpwood camp, one mile inland, the stream is a succession of falls. Two miles and a half from
the mouth the bed is 250 feet abov
At this point the rock is gneiss, b
at once to the south into a band
loid striking east. Three-quarter
farther down the stream a conglo
against the latter which are both d
Keweenaw age."

Corby Point.

There is a steamboat landing a
station on the east side of the p
protects the bay from th
west winds; and a
stands a mile or two south on Cor
The village is not a savory one, sin
of the fish taken is dumped not fa
ing a perpetual attraction to gulls
and the idle horses of the lumbe
the point at will. Lumbering will
in this region, the pine having bee
as well as much of the spruce, b
cedar. The material left is most
as pulpwood, of which we saw la
ties in the more inland parts.

The Mamainse Region.

Roussain's Station.

Rounding Corbeau point we foun
wind to coast with canoes and sail
to Roussain's fishing stat
there is a small snug ha
tiny settlement. The shore here
very rugged, consisting of blac
rock in thick layers, separated
amygdaloid and conglomerate. A
rocks are soft and easily attacked
they wear away along the shore,
harder eruptive masses standin
stacks and islands. Many small
eaten by the waves in the softer
harder layers roofing them over.

Mamainse Harbor.

The next point stopped at was
harbor, where narrow channels bet
islands and the shore m
harbor. Sand bay, whe
of the same name is located, is a n
south, but affords little shelter
The mine is not working, being le
of a caretaker who served us as gu
the different pits and shafts. As
has been described by Mr. Blue,[11]
be said of it here. A mile north

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[11] Bur. Mines, 1893, p. 66, etc. R
the literature are given here.

at a small costean pit, there is a plate of native copper eighteen inches long by an inch in thichness standing up from the decayed amygdaloids. This and the pile of ore rich in native copper at the main shaft give evidence that the metal is present in considerable amounts.

Mamainse Copper Mine.

About two miles north of Mamainse harbor is the old Mamainse copper mine, worked, it is said, 46 years ago, and again 17 years ago, where a village of 30 houses without an inhabitant may be seen. The houses have stone foundations and are well constructed frame buildings in a fair state of preservation except for doors and windows, all of which have been carried off. There is a church, two shaft houses, and a large mill containing crushing and concentrating appliances. There is very little ore to be seen on the dumps, which evidently consist of waste rock, mainly amygdaloids. The site is an attractive one, but with a very poor harbor. Rugged strips of black amygdaloid and trap run out into the lake with curving beaches of well-rolled pebbles between. The village stands on a low terrace, with wild flowers, red and white clover and wild strawberries all about, and a pretty stream flowing into the lake.

Pointe aux Mines.

Geology of the Point.

Beyond Mamainse rocks apparently of Laurentian and Huronian age show themselves, red granite and gneiss penetrated by dark green dikes and also great masses and dikes of a very coarse grained pegmatite or giant granite, having flesh red felspars as large as one's hand embedded in a coarse grained granite ground mass. Here and there are strips and masses of Keweenaw rocks leaning up against them, often with a basal conglomerate or breccia of gneiss and granite at the bottom. A few beds of brown shale and sandstone, probably Cambrian, occur at the foot of bays.

Ruins of the old Mine.

Pointe aux Mines from the south seems to be a mixture of Laurentian and Keewatin rocks, but to the north shows amygdaloids and conglomerate having the usual rugged shore formed by Keweenawan rocks. The mine is a few hundred yards inland from the landing place in a bay north of the point. On the hill side there are the ruins of two or three buildings with massive stone foundations, and the opening of a tunnel with its timbers all rotten and falling in. There are several deep pits farther up the hill and several heaps of rock from the excavations, with little amygdaloid and no conglomerate to be seen. There are also two heaps of slag containing a number of tons resulting from smelting operations. An assay of this slag gave 1.20 per cent. of copper. This mine is reported to have been worked 46 years ago, and is said to have been attacked by Indians. For its defence two cannon and a body of militia were brought up, according to Sayers, the captain of our fishing boat.

There are several heavy square iron stamps on the beach, perhaps landed but not put in place at the mill. In all there must have been a large amount of work done at this mine, but there is now very little ore to be seen, perhaps because all that was obtained had been smelted. Young trees are now growing among the ruins of the buildings, and from the shore there is nothing but woods to be seen.[12]

Features of the Coast Line.

To the north of Pointe aux Mines in a large bay flat lying sandstones, like those of the last bay, probably St. Mary's sandstones, cover a wide area beneath the shallow water and appear to slope off towards the open lake. The points however are of Laurentian, containing fewer Keewatin inclusions than farther south. The scenery is magnificient, granite cliffs rising 500 feet above the lake. A curious cave shows at the northern point of the bay and two others at 30 and 50 feet above the water, probably old shore caves. Here small patches of conglomerate with gniess and granite pebbles lean against the granite and are with difficulty distinguished from it. Old chasms in the Laurentian are filled with this rock, proving that an old shore stood just at the level of the present shore and presenting the same conditions. This conglomerate is probably Keweenawan. As the cement is soft it easily weathers out and sets free the

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Cf. Macfarlane, Geol. Sur. Can., 1863-66, p. 144.

pebbles and boulders of the old rock to be washed on the present beach as if recently made. A remnant of conglomerate rests against the edge of a large diabase dike and contains boulders of it, showing that the dike is older than the Keweenawan.

These diabase dikes are exceedingly numerous along this part of the coast and have much to do with its shape. Sometimes the dike is the more resistant rock and rises as walls, protecting the softer rock behind or serving as breakwaters for small harbors or forming narrow islands or long points, features noticed by Logan in the Geology of Canada. At other times the dikes are less resistant and weather out, forming narrow deep ravines with walls of gneiss. The general strike of the dikes is about northwest and two of them project sharply, one on each side of Montreal river forming a sort of harbor, not well protected however from northwesterly winds.

Montreal River to Little Gros Cap.

Features, Geology and Scenery of Montreal River.

Montreal river is probably the largest stream up to this point on the shore of lake Superior. There is a bar at its mouth, above which fishing craft find a safe harbor, though the powerful current is not easy to meet unless a line is taken ashore for towing. The scenery of the harbor is splendid, with its two rocky points and the reddish Laurentian mountains in the rear. Three forest-covered terraces rise above the bay, indicating former higher levels of the lake; and at the inner end of the bay one catches glimpses of the white series of cataracts flowing through a deep narrow canyon by which Montreal river finds its way down from the mountains to the shore. The river was explored six or seven miles inland, and for that distance is very difficult of navigation, being a succession of falls for the first mile or two and then short stretches of slack water separated by long flat rapids up which one must pole.

Instead of following the river up from the bay at its mouth it is necessary to portage south past the point enclosing the bay on that side and then, after a few hundred yards paddle, one climbs up from the shore, following a trail for some distance on level ground and then up an ascent so steep for 180 feet that canoes cannot be carried but must be dragged. A quick descent leads down from this ridge to the placid river above the main fall, which has in all a height of 172 feet (aneroid). There are two more respectable falls on the way up the river, which rises 250 feet as shown by aneriod in the first six miles. Five portages were made on the way up, but returning all except the three main falls may be run in a canoe.

The river is clear, with slightly brownish waters, and there has been no fire on its shores, so that beautiful woods run to the top of the highest hills when not broken by faces of rock too steep for trees to grow. A good deal of white pine is scattered through the woods; and spruce and cedar are common, some of the latter being of good size. One which was measured had a diameter of 3 ft. 10 in. at the butt. Apparently no lumber has been cut on this river.

There is no agricultural land to be seen as far as we ascended the river, perhaps largely because it flows in a narrow valley below the general level of the mountainous country around.

The rocks observed are Laurentian, with several large inclusions of Keewatin, and some masses of coarse grained red granite and flesh colored pegmatite. These rocks are cut by two systems of diabase dikes, like those whose lakeward projection forms the harbor. It is probable that the canyon through which the river flows in its final cascade was made by wearing out and removing the materials of two such dikes, meeting nearly at a right angle. This would account for the fact that the canyon walls are not vertical, though parallel to one another. The one on the left bank overhangs the river several degrees and stands in places fully 100 feet above the torrent of foam at its foot.

The scenery along this part of the river is extraordinarily wild and romantic, and can scarcely be equalled elsewhere in the Province. It is singular that in its striking canyon scenery this western Montreal river is very like the eastern river of the same name emptying into the Ottawa.

Professor Willmott reports as follows regarding the Agiwa (Agawa or Aguawa) river, entering the lake about seven miles north of the mouth of Montreal river :

Agiwa River.

"From the mouth of the Montreal river to a point three miles south of the Agiwa the shore consists of gray gneiss frequently much contorted. Some masses of pegmatite occur, and many Keewatin-like inclusions were seen. There are numerous dikes of greenstone, occurring usually at points, and all bearing 80° to 100°. A sand plain extends south from the mouth of the Agiwa for three miles. It is covered with a fine forest of Banksian pine, straight and branchless for 40 to 50 feet. Just north of the mouth the shore becomes gneiss again. An Indian village and a Hudson's Bay Post were once situated here, but the buildings alone remain.

"The river flows so rapidly near the mouth that it can only be ascended by poling. At one point the current was estimated at four and a half miles an hour, and the width at 150 feet, and the average depth at three feet. Travelling inland, two fine terraces were found at 111 and 126 feet above lake Superior. On the first terrace was an excellent hardwood bush which had been extensively used by the Indians for sugar-making. There is here an area of some extent well adapted to agriculture."

Montreal and Lizard Islands.

Montreal island, which lies five miles northwest of the mouth of Montreal river, is covered with wood, presents no rock to be seen from a boat cruising like ours, and is without hills. Bayfield reports that it consists of sandstone, probably like that at Sault Ste. Marie.[13] The Lizard islands seven miles farther northwest give a good landing and harbor, and so are used as a fishing station. The rock is to be seen here as flat lying sandstone rising only three or four feet above the water. It is mottled and banded with red and white, and has all the characters of the St. Mary's sandstone. There are a few houses inhabited by fishermen on the main island, and at the time of our visit also a family of summer residents. The island is said to be free from flies and to be the home of many lizards (salamanders). The fishermen state that the water of lake Superior has fallen of late years ; but their houses, evidently a number of years old, now stand only two or three feet above the lake. It is not likely they would have been built any nearer the shore than they are now, which suggests very little change in the level of the water. There are no large trees on the island, perhaps all have been cut off.

Sand River.

Sand river enters lake Superior just east of Lizard islands, and forms a series of falls and rapids for about a mile inland, when comparatively quiet water is reached. In the ascent three well-marked terraces are passed at heights of 72, 144 and 234 to 260 feet (aneroid). The main fall, of 95 feet, is about a mile inland. There is a very good portage path to the quiet water at the head of the rapids, nearly 200 feet above the lake, suggesting that the river is used by Indians ; unlike Montreal river, where the portages are badly grown over and hard to find and follow. It is, however, much smaller than Montreal river. The rocks seen are mainly gneiss, striking nearly east and west and pierced by coarse granite of pale flesh color. One fall is formed by a dike of diabase cutting the gneiss.

Leach island and Gull rock.

Leach island, five miles west of the Lizard islands, shows no rock on its north shore, though gray flat masses of St. Mary's sandstone may be seen under shallow water near shore. The beach is formed of fragments of the same rock, which no doubt underlies this low wooded island. Gull rock, north of this on the way to Gargantua, is of the same sandstone. This rock is used as a breeding place by the gulls, whose half-grown squabs scramble over its stones, while hundreds of fully-fledged birds hover and scream about it. The young gulls are very stupid and helpless creatures, but good swimmers. If tipped on their back in the water they lie there without attempting to right themselves. The young birds are said to be fat and good eating by the Indians, and the eggs are often gathered and eaten by fishermen and Indians earlier in the season. Sayers says that they incubate about the same length of time as common hens, and that the first fowls kept on Caribou island, a fishing station far out in lake Superior, were hatched by gulls from hen's eggs.

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[13] Geol. Can., 1863, p. 82.

North of Leach island on the main shore patches of a basal conglomerate containing granite boulders were seen, probably of Keweenaw age, but no amygdaloids ; though there is a curious rim of red agglomerate or ash rock dipping about 30° away from the upturned gneiss in a bay just south of Gargantua harbor.

Gargantua Harbor and River.

Gargantua harbor is a picturesque bay south of the cape of the same name. It affords good shelter for fishing boats and the small steamers used in the fishing trade, including the Telegram, and could accommodate vessels of a much larger class. An island of rock rises in the mouth of the bay supporting a small lighthouse whose lamp is 85 feet above the lake, the only light between Corbeau point on Batchawana bay and Quebec harbor on Michipicoton island.

The rocks at the harbor consist of reddish granite or gneiss sometimes containing large masses or angular fragments of gray gneiss or schist, forming at some points almost a breccia. There are dikes of coarse pegmatite and of diabase penetrating the Laurentian rocks. A hill used as an observatory during the hydrographic survey of the coast by the United States government rises 431 feet a little to the north of the bay.

A fringe of amygdaloids extends along part of the shore and the small adjoining islands to the northwest of the harbor at cape Gargantua, resting directly on the gneiss without any basal conglomerate between. Many agates are found in the amygdaloid and as pebbles on the shore. The light keeper, Louis Miron, has found native copper also.

Gargantua river enters the lake south of the hook shaped promontory of the cape, but as it does not seem to be a very important stream it was not ascended as far as the falls or rapids.

Just north of the cape there is a small patch of red Keweenawan conglomerate and also of red volcanic breccia at the foot of a bay, remnants of a sheet of rocks once covering the whole shore and perhaps still existing below the level of wave action.

A cascade 90 feet high is seen close to the shore a little farther north, and fine mountain scenery all the way from Gargantua to the wide flat valley of Michipicoton river.

Only a short stay was made at Michipicoton Post near the mouth of the river, as it was intended to examine the gold region near Wawa lake to the north on our return journey.

Little Gros Cap and Doré River.

The rocks at Little Gros Cap, five miles west of the river mouth, and near Doré or Pickerel river just beyond, were included by Logan in his original Huronian, and were studied by us for a day or two because of their geological interest ; and Doré river was ascended for about two miles to examine its falls and rapids. The river is very bad for canoeing and cannot be much used, since only the first fall has a path cut for portaging. The first fall, which is close to the shore, is only about 20 feet high, but less than a mile above there is a fall of 78 feet (aneroid, two readings), and the height reached in two miles is about 310 feet. In this distance we were obliged to make six portages, mainly over rock ; and the river at one place flows through a small canyon not more than six feet wide.

Schist Conglomerate.

The rocks observed were boulder conglomerate near the lake and felsite schist with a few bands of chlorite schist to the north as far as we proceeded, all Huronian. A high steep hill near the mouth of the river consists of diabase, probably a mass erupted through the Huronian. The strike runs from 60° to 80° east of north, and the dip is from 70 to vertical. The schist conglomerate at the mouth of the river has been described by Logan, who gives a detailed section having a width of 1,700 feet, and states that the series of slates (schists) must be much greater than this. A micrometer measurement to a small island of the same rock nearly south of the river mouth gives the distance as 2,500 feet, and the conglomerate has been found ⅛ of a mile inland, or 650 feet farther. These conglomerates, which are very like those of Shoal lake in the west, extend in patches for about three miles along shore toward the west, and contain a few barren looking quartz veins. Still farther west granite cuts off the schist conglomerate eruptively, and is followed by green schist. More or less conglomerate occurs at intervals however as far as Dog river.

Dog River.

A View of old Lake Terraces.

For three or four miles east of Dog river a magnificient series of old lake terraces fronts the shore, best seen from a mile or two out in the lake. They are clean cut and very well defined, and consist chiefly of sand and gravel. The highest rises about 360 feet above the river, and the even level lines of the forest-covered surfaces of the successive steps are very striking in contrast with the rugged cliffs and dome-like mountains elsewhere seen on this wild coast. These terraces extend only a short distance west of Dog river. Two miles west of the river there is a sheltered little harbor, well adapted for fishing craft, though deserted when we were there; and a few shanties stand along the sandy shore of the bay and near the rocky point which protects the small pier and storehouse.

The River and its Falls.

As Dog river is one of the largest streams on this part of the coast we devoted some time to its study. There is a long gravel bar at its mouth, crowding the brown water of the river against the cliff on the west side of the valley. About half a mile above this the river becomes too rapid for canoe navigation, flows through canyon-like narrows parallel to the strike of the Huronian schists, and finally turns off at right angles, forming one of the most beautiful falls we had yet seen. The foot of the main fall is about 33 feet above the lake, while its head is 159 feet higher (aneroid). The fall is in three steps, but all visible from one point of view. Above the fall the stream once more turns parallel to the strike of the schist, following a narrow canyon. From the appearance of the shores it is evident that the river has great fluctuations in level. The rocks seen are pale green schist conglomerate and porphyroid.

Speckled Trout.

In this and rivers visited before, speckled trout are plentiful, sometimes the real brook trout. Our captain caught several fine fish from the pier in the harbor, one measuring 19½ inches in length. The red spots are not so bright as in the brook trout, and are surrounded by a small bluish halo; otherwise these fish are very much like the brook trout in appearance.

West of Dog river to the mouth of Eagle river various green Huronian schists are found, penetrated often by felsite dikes. West of this a reddish or gray granite mass bursts through the schists and is itself cut by dikes of diabase.

Pucaswa River to Pic River.

Geology of Pucaswa Harbor.

Our next important stop was at Pucaswa[14] river, where two small islands form a tiny harbor, very welcome after long pitching in a high sea; and a stretch of sandy shore affords good camping ground, though infested with sand-flies and blackflies. The rocks here are chlorite schists with purplish felsitic layers, crossed by numbers of large diabase dikes having the crumbling look of Keweenawan rocks, though perhaps not of that age. One of these dikes, forming a point just west of the river mouth, is cut by a smaller columnar dike, which has been breached by the waves so as to give a tunnel-like opening through the point. The cave is about 30 feet long by 15 in width and height. The basaltic columns are six feet long and tilted to about 45° on both the roof and floor of the cave.

Cascades of the River.

There were many fresh caribou tracks on the sand near the mouth of the river. For about a third of a mile beyond the bar there is little current, but there the valley turns off through a wild gorge overhung by a cliff hundreds of feet in height. A portage path of half a mile leads past the series of cascades by which the stream breaks through this barrier, the only well beaten portage found on the whole river. The first fall is of about 55 feet, and a series of rapids rise beyond this. There is a mass of pyrites a foot thick at the foot of the rapids, at which some one has done a little work ; but there is no quartz accompanying it, and the deposit shows little promise.

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[14] The name is variously spelled, Pucoso, Pukasquaw, etc., but the spelling followed here corresponds best with the pronounciation of the Indians employed as guides, though one of them spel'ed it Bagoswa when asked to write it down.

At Kilkenny Harbor.

A little west of Pucaswa granite shows itself as far as Kilkenny (or Killarney) harbor, now deserted ; beyond which there is gneiss with a strike of about northeast and southwest and a dip of 80° to the northwest. In a bay west of Kilkenny there are several old beaches rising above the water to a height of 42 feet, the upper ones completely lichen-covered. There is no sharp break in the series of beaches, which all consist of well-rounded boulders about as large as one's head. This seems to imply a gradual fall in the level of the lake.

The Dikes of Otter Head.

Between this and Otter head the scenery is very striking, pale gray or flesh red gneiss being penetrated by many wide diabase dikes of a very columnar character, often, when weather-beaten, suggesting great piles of cordwood. As the head is neared the gneiss becomes interbedded with long bands of gray or green schist, showing an eruptive contact of Laurentian with Huronian, like that seen in the Rainy Lake region.

There is a long bay with mountainous shores to the north of Otter head, and a large island protects its mouth, so that the sheet of water is as placid as an inland lake, forming a great contrast with the turbulent waters of lake Superior, which are seldom free from ground swell even in the calmest weather. On the north shore of the bay, where a waterfall tumbles over a dike of diabase in green schist, a mining location was taken up some years ago by Mr. Mudge, of Peninsula. There are some small veins of quartz charged with pyrites, supposed to contain copper, but showing when assayed no copper and only $2 per ton in gold and silver ; so that nothing further has been done with the property.

Rideau River.

On the main land opposite Otter island the Rideau river falls as a cascade visible for a long distance on the lake. There are two falls in succession, having in all a height of 86 feet.

White Spruce Harbor and Tip Top Mountain.

From this point to White Spruce (or Spruce) harbor no stop was made.
latter point there is a well-sl
bay, once a fishing station,
frame houses, pier and sto
are now abandoned. Fro
we attempted to ascend Tip Top mc
marked on the map as seven miles
east, but owing to the shortness of th
noon available for the work and th
rain which came on, we did not s
The trail is faint at present, though
have been considerably used when th
mit was occupied as a triangulation
by the U. S. Hydrographic Survey
blazed trail as far as we could follow
up a small creek past a lake about a h
long and then up an extraordinary ra
canyon, evidently the result of the w
ing out of a diabase dike. Though
few feet wide it had a depth of about 1
with smooth parallel walls of granit
having a dip of 80°, so that one wa
pletely overhung the path. On an ad
granite hill top at a height of 9
(aneroid) we found an old triangle o
perhaps used as a temporary observa
signal, and had a magnificent veiw
mountainous country around, though
what shrouded by mist and rain.
point, or rather dome, three or four n
the east was probably Tip Top[15] ;
number of higher hills than the one
climbed were in sight, ours representi
much more than the average height
part of the shore. No land of any
fit for agriculture was passed on our
sion.

The rocks observed were granite or
toid gneiss, with diabase dikes. At
harbor the rock is gneiss imperfectl
ated, with no very distinct strike.
a small gull rock three miles to the
west we found gneiss with a strike of 8
a nearly vertical dip. A young gull
up here, though not yet able to fly,
spread of wing of 45 inches. All th
were fledged or nearly so at this tim
their islet was very foul from the deb
upon it.

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[15] This mountain was ascended on my journey going in from Swallow river to the

White Gravel River and Oiseau Bay.

A short stay was made at White Gravel river, a small stream north of Spruce harbor, and a longer one at Oiseau bay ten miles north of it. Unlike the coast observed hitherto, we found that along this part a number of points had been burnt over, as if the climate was drier than nearer to the Sault; and the lofty hills along the shore had a very barren look. The only timber of value is spruce, both here and on the route of our excursion towards Tip Top mountain. Of that, however, there is a considerable quantity. At Oiseau bay there is an interesting succession of rocks displayed. Yellowish Laurentian gneiss, containing black bands of older schist, probably Keewatin, is cut by gray granitoid gneiss, and all of them are intersected by pegmatite. The gneiss has a strike of 150°, but a mile beyond this it has changed to 60°.

From this point to Heron Bay the shore as far as observed by us consists of green schists cut by dikes of granite and larger areas of coarse reddish-gray granite, perhaps Laurentian.

Pic River to Heron Bay.

At the mouth of Pic river sand bars and dunes form the shore; but just beyond this a rocky point consists of what appears to be Huronian schist, with a strike of 110°-120° and vertical dip. Rounding the point and turning north into Heron bay there are reddish rocks, at first taken for gneiss or granite, but proving on more careful examination to be schist conglomerate, consisting of pebbles or boulders of quartz porphyry and other rocks in a darker matrix. This rock forms almost the whole shore of the bay.

Heron Bay.

At Heron Bay we were delayed a day or two in getting guides and canoemen for our projected trips south from the C.P.R. to lake Superior, owing to the fact that all the Indians of the reserve were waiting for the most important event of the year, viz., treaty payments. After our lonely journey along the deserted shore of lake Superior where for about 70 miles, from Ganley's harbor to Heron bay, there is not a settled inhabitant, the bustle was not uninteresting.

Iron San deposit at Peninsula.

Heron Bay Mine.

A day was spent in walking along the railway to Peninsula to examine the rock formations and to visit the immense gravel deposit on the way. West of Heron bay to mile 805 the schist conglomerate is found; beyond that, greenish gray slate with many dikes of diabase. As the rocks near Peninsula and along the railway for some distance west were referred to in a previous report, no mention need be made of them here.[16] The iron sands referred to in the same report,[17] were examined under the guidance of Mr. M. J. Paterson of Toronto, who was engaged with Mr. Mudge in collecting bags of the material for a test of the value of the deposit. The area of sand containing magnetite is large, 1,200 acres we were told. An assay of one of the best samples taken by us yielded 48.6 per cent. of iron. The Heron Bay mine close to the station of the same name was visited also. A shaft 40 or 50 feet deep has been sunk in a country rock of felsite; and the ore on the dump consists of calcite with a little quartz and pyrite, not very promising in appearance.

Pic River.

Pic river is one of the largest on the north shore of Superior, and has falls of some importance, but too far inland to make it advisable to ascend it for the purpose of examining them. Where the railway crosses the river half a mile east of the station its width is 225 feet. The water at the time we visited it was exceedingly muddy, justifying the name, which is said to mean "mud" in Ojibway.

Michipicoton Mining Division.

Plan of Exploration Tours.

By the kind aid of Mr. W. H. McDougall, a fur trader who has a store at White River as well as at Heron Bay, Indians and equipment were secured for Prof. Willmott and myself, and on July 20 we commenced our respective journeys southward, my starting point being Bremner Station of the C. P. R.; Prof. Willmott's, White River. It was arranged that Mr. George should accompany Prof. Willmott, and Mr. Coulthard and Sayers should sail the Caribou down to Caribou island while we were occupied with our canoe trips, so as to examine the rocks composing that seldom-visited island ; and then to return to the north shore and pick us up at the mouth of Pucaswa and Dog rivers, respectively. This programme was carried out punctually by the three expeditions.

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[16] Bur. mines, 1897, p. 133. [17] Ibid, p. 83.

Bremner River.

Bremner Station to Lake Superior.

Going east by rail from Heron Bay to Bremner river my party of four, including two Indians, Toussaint Weesiau and Jim Shoes, engaged as canoeman, set out on July 20 through a region only partly known to the Indians and rarely traversed by a white man. We were told it would require two weeks of hard work to cover the distance to lake Superior, about 45 miles in a straight line ; but of course much farther by the small and winding rivers we were to follow. It required in reality only about half that time, although the carrying on of the survey with prismatic compass hindered our progress considerably. Bremner station is on White river, but a quarter of a mile up stream we turned off to the south on Bremner river, which seems the larger of the two branches, and followed it up to its head waters which reach more than half way to lake Superior. About four miles up the first rapid requiring a portage is reached, and the first outcrop of rock also occurs, gneiss with an east and west strike. The portage, which is on the right bank going up, is about a fifth of a mile long and well beaten. The rise is about 10 feet. The next rapid, about a mile farther up, has a fall of 32 feet (aneroid) ; and is passed by a crooked trail on the left side about three-quarters of a mile in length. Another rapid is passed less than a mile beyond, with a fall of nine feet and a portage of 100 yards on the right side. The rock exposed here is gneiss with dikes of diabase. A large creek enters the river from the left about 12 miles from Bremner, in a region of low sandy banks ; and half a mile beyond this hills that have been burnt over were found to consist of fine grained pale gray granite, covered with the black trunks of jack pines.

Ascent of Bremner River.

The timber up to this point on the river is chiefly jack pine, though on the lower ground some spruce and tamarac are to be seen. My cook, Stephen Jollineau, who has worked for a pulpwood lumber company, sa spruces would make good pulpwoo cutting two logs 16 feet long.

Above the last rapid mentione grows smaller and very crooke only a gentle current. Several s follow, with short portages scan beaten, over gneiss or granite ; bad portage one-third of a mile fallen timber past a series of rapi total fall of 60 feet (aneroid) ; and on there are numerous small r slack water between.

About 23 miles from Bremner suddenly becomes straight for miles, much of the way having a st or gneiss wall on the left bank. T part probably follows the line of dike which has weathered out, form canal. At a rapid having a fall of stream is at one point so narrow th easily step across. The channel f strike of the gneiss.

Headwaters of the River.

The stream now grows more than ever for two or three m then straightens again for a same distance, three sm entering it meantime from After another bend and a expansion we at last reach the head Bremner river in a lake about a length, called by the Indian fami hunts over this region Peenay or lake. The lake is surrounded by low hills of granitoid gneiss, the highest ri haps 100 feet above it. The pale gneiss many angular fragments of dark gre

The whole rise from Bremner s Partridge lake, as determined by sum the heights of the different rapids by aneroid, is about 200 feet. A very little current between rapids o feet need be added to complete the of the headwaters of Bremner riv the railway. As Bremner Station i above lake Superior, the fall from lake to Superior is 725 feet.[18] Touss

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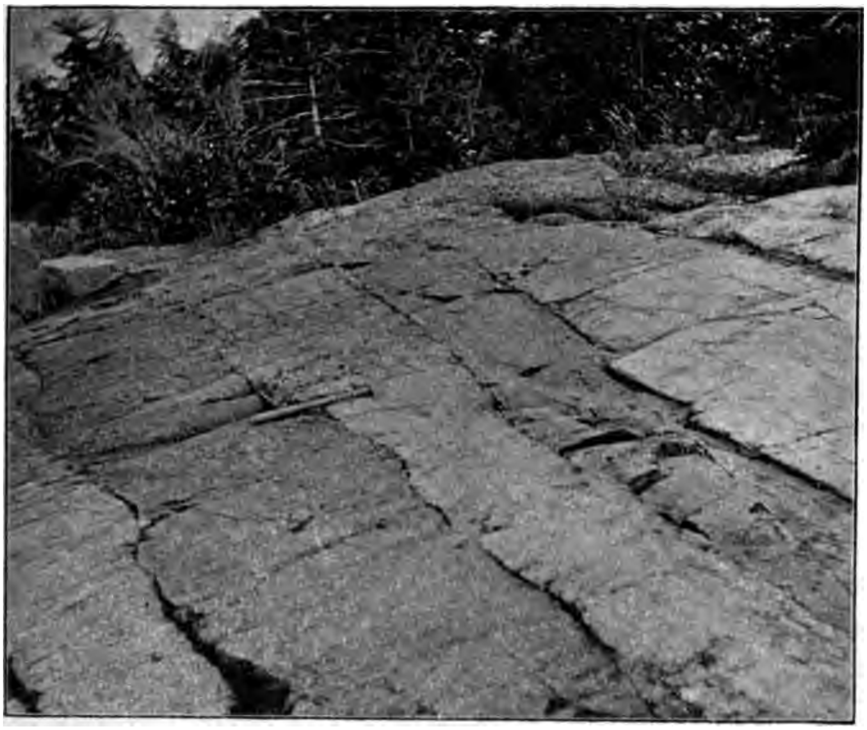
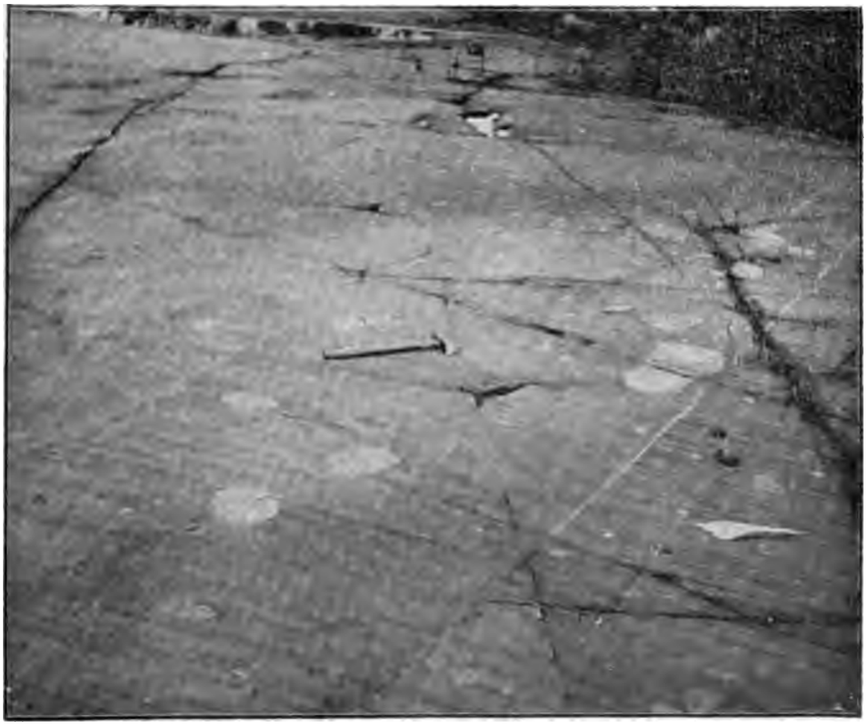
[18] **Mr. J. White of the Geological S kindly informed me that the elevation o station above sea level is 1,129 feet. S 602 feet, the height of lake Superior sea, gives 527 feet.**



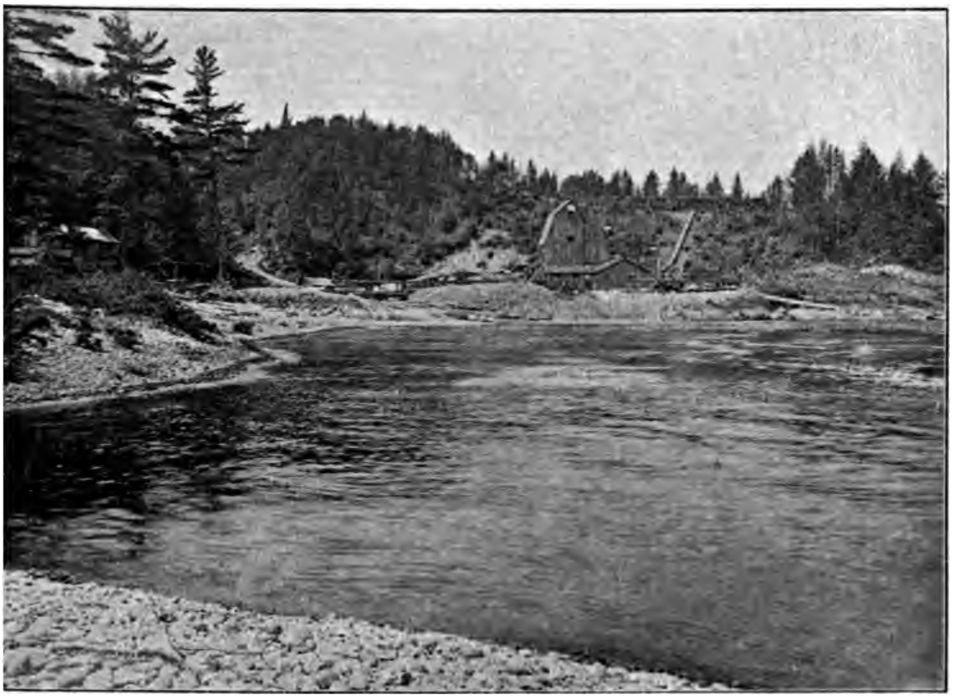
Dikes of Greenstone in Quartzite at Island one mile east of Bruce Mines. Willmott



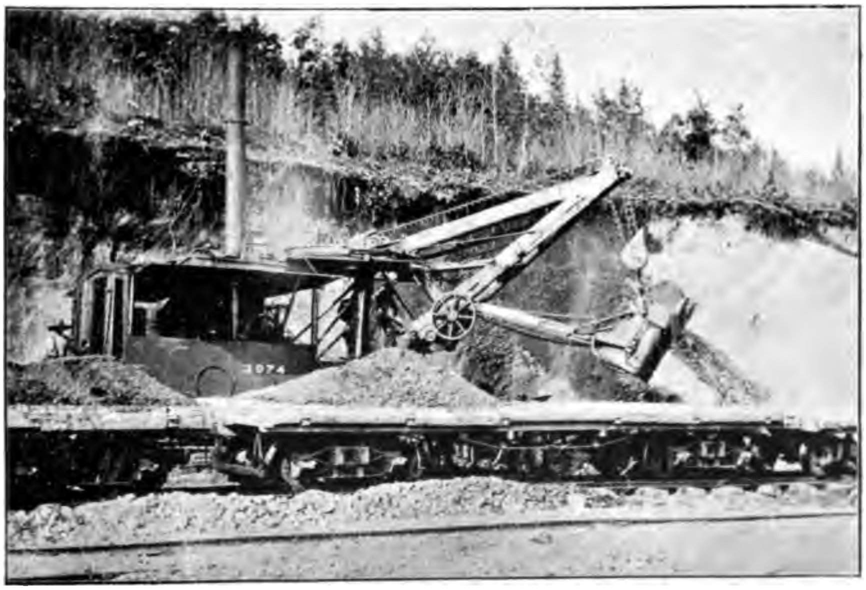
Murray's Lower Slate Conglomerate, showing a Gneiss pebble, a faulted pebble, joints and glacial striæ.
Palladian Islands, four miles east of Bruce Mines. —Willmott.

Gorge of Mississaga River Cheney.

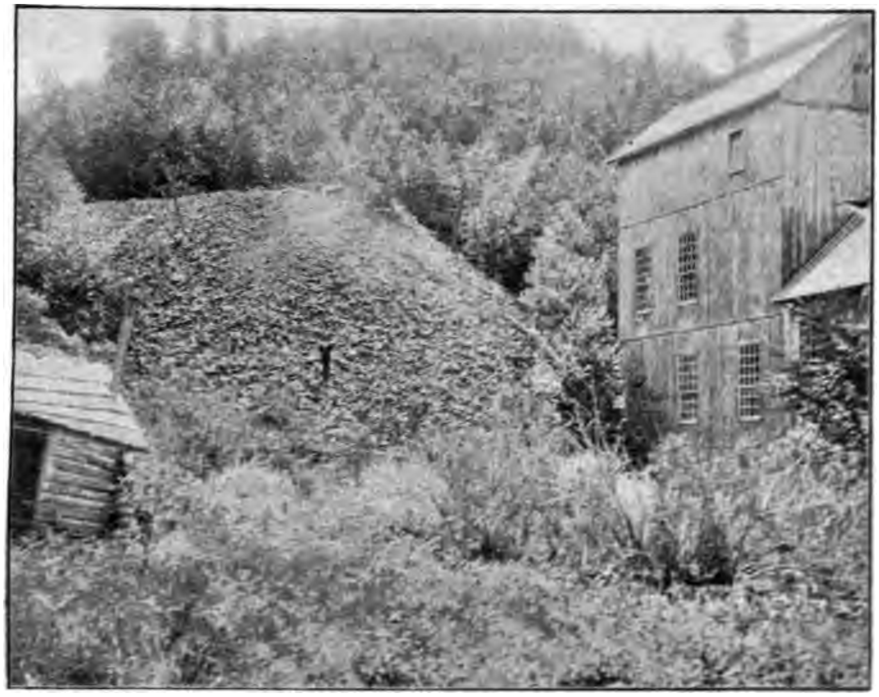
Baboon Falls on Mississaga River Cheney



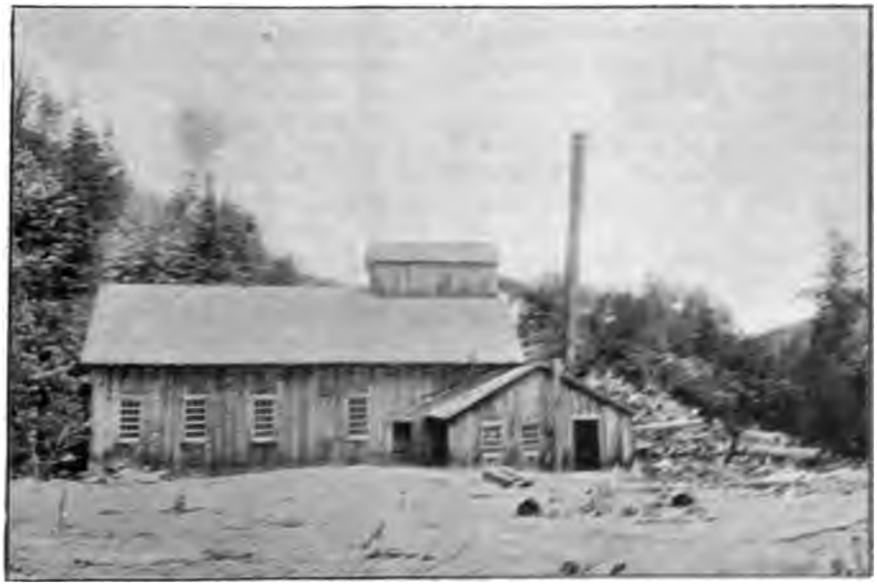
Shaft House at Cheney Mine. Cheney.



3 Steam Shovel excavating Gravel Beach back of Garden River Station, C.P.R. Willmott.



Mill and Rock Dump at Victoria Mine [illegible] [illegible]



[illegible]

along this valley, states that a lake a
›r two away empties by a small creek
Partridge lake and also into the head-
s of Pucaswa river.

scenery of the river is not striking.
of its shores has been burnt over, and
mber left is of little value except for
ood. Jack pine, birch and spruce are
mmonest trees ; but tamarac and cedar
und occasionally. There are unusually
kes along the stream, and those are
ly more than pond-like expansions of
ver. The shores being generally low,
few exposures of rock except at rapids ;
he only rocks observed are granite,
and dikes of diabase.

Pucaswa River.

ortage 2¼ miles long, broken however
ee little ponds, leads southeast, across
very rugged and hilly country with
ds. no distinct path, to a small creek
g into Pucaswa river. The fall from
dge lake to canoeable waters flowing
ne Pucaswa is 126 feet. Much of the
e leads across flat-topped granite hills
are rock ; but there are long stretches
skeg and meadow as one approaches
wer end of the portage. The hills
covered with blue berries when we
d on July 23 ; and the Pucaswa waters
ed us with plenty of speckled trout.

little creek at which the portage ends
larger stream which flows 2¼ miles
of southwest to meet the main Pucaswa
swa river flowing first west and then
rest. After crossing the divide there
o beaten portages and we simply worked
y down stream over endless flat rapids,
much of the time. The reason why
dians never navigate the river was
although the presence of caribou tempts
o the headwaters of the Pucaswa in
. Beaver cuttings were plentiful on
rt of the river.

w miles below the forks the stream
s, enclosing a wooded island a mile and
r- a half in length. About 15 miles
above its mouth the shore at a
hows many black masses of hornblende
probably Keewatin in age, the first
her than Laurentian gneiss observed on
the river. The gneiss thus far seen generally strikes about east and west. With the exception of a few narrow lake-like parts, the river down to this is almost a continuous flat rapid with a few higher falls, the portaging being done generally down the bed of the shallow stream ; only striking into the woods where falls of some height occur. About 11 miles from the mouth red granite or graintoid gneiss is seen at a rather lofty fall (27 feet) and continues for some miles down stream. Below the main fall there is a continuous series of rapids for a mile and a quarter with a fall of 198 feet ; a difficult bit of river with such precipitous rock walls as to make portaging very laborious. This part of the river contains many elongated islands among the rapids, and presents a series of magnificent views. Here for the first time a distinct sand and gravel terrace indicating an old lake level is to be seen rising 40 or 50 feet above the river, and the valley has been cut low enough into the high tableland to give its rocky walls the appearance of mountains.

A little more than seven miles above lake Superior, following the windings of the river, here very crooked, but only three miles in a direct line, Huronian rocks first show themselves in continuous beds, having a strike of 80° or nearly east and west, and running parallel to the course of the river. The dip is from 30° to 45° to the north. The red granite observed for several miles above this is probably eruptive, perhaps a continuation of the granite area found on the shore of Superior a few miles east of the mouth of the Pucaswa. The strike of the green schist varies somewhat, being 60° a mile lower down.

About 4½ miles from its mouth the Pucaswa is joined by a smaller river from the left, estimated at a quarter of its volume. Just above this there are two falls having a total drop of 22 feet, and near by a small bedded quartz vein with pyrite was observed. A mile below the tributary felsite schist occurs, having a strike of 30° and dip of 30° to the northwest ; and the river passes through a canyon where many dikes of diabase are seen. Below the canyon there is a soft gray rock much seamed with small veins of calcite. A succession of flat rapids and one fall of about 18 feet intervene between the canyon and the main fall of the river, 55 feet high, below which there is a lake-like expansion reaching to the bar separating the river from lake Superior. The river mouth has been described in a previous part of this report.

Readings of Elevation.

There is a considerable amount of spruce, some of it large on the lower reaches of Pucaswa river; but besides the timber nothing of economic importance was observed on the whole route from Bremner to Pucaswa harbor. Summing up the results of aneriod readings from the foot of the long portage which leads from Partridge lake to a tributary of the Pucaswa, the whole fall is 575 feet. As there is a fall of 126 feet on the long portage this gives the elevation of Partridge lake, the headwaters of the Bremner river, as 700 feet. This result must not be looked on as having great accuracy however, and the estimate made from Bremner station, 725 feet, is probably more correct.

An inhospitable Region.

The Pucaswa as a whole is one of the most difficult rivers in Ontario to navigate, being almost a succession of rapids, some with very shallow water over small boulders ; others are considerable falls over solid rock. There are few stretches of dead water and no lake of any magnitude on its whole course. Since the Canadian Pacific Railway crossed the country to the north it is never navigated even by Indians, though we found two families of Indians camped at the mouth of the river for fishing purposes. They came from Pic river in a sail boat however. In winter the country is more accessible than in summer, and a few Indians hunt caribou along parts of the Pucaswa.

Herrick's Roadway Line.

The roadway surveyed by T. W. Herrick in the summers of 1857-9,[19] running about 20 miles inland through the whole region from the Sault Ste. Marie along the north shore of lake Superior, was apparently never cut out, and will never be made use of since the railway has been carried through the northern part of the district. His work seems to have grown up so as to be unnoticeable from the river. The line is mapped as running past the headwaters of the Pucaswa ; but was not observed by my party in portaging from Partridge lake. He represents the river on his map but makes it straight except at the lower end, probably having sketched it in from the reports of Indians. For a few miles above its mouth the Pucaswa is fairly well mapped in the plan of the township of Homer in the Crown Lands department. Bremner river and Partridge lake are not shown by Herrick, though his line must have come close to them.

Bell's map of the "Basin of Moose River and Adjacent Country," illustrating his work in 1875, 1877 and 1881, and published by the Geological Survey in 1883, does not make use of Herrick's work. A tributary of White river, Oskabookuta river, is dotted in, probably from Indian reports, in such a way as to make it meet or even cross Bremner river near its headwaters. It is probable that the river is not as long as represented, as my Indians, though they had canoed ten miles up it from White river, were not aware that it approached Bremner river.

The Story of a "salting" Swindle.

Twenty-seven years ago two townships were surveyed on this part of the barren shore of lake Superior, Homer and Byron, and the old lines may still be seen in the woods. As the history of the affair, which included the "salting" of a tin mine, is of some interest, Mr. John McAree, who took part in the survey, has been asked to write an account of it. This is given in the footnote.[20] In later times deposits of copper ore have been found in or near these townships and may prove of value.

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[19] Upper Canada Surveys, 1860-66.

[20] McAREE'S NARRATIVE.

The township of Homer was surveyed by the late C. C. Forneri, P.L.S. of Port Arthur and the writer in December, 1871, and January, 1872, for W. A. Northrup, who came to Port Arthur from the south shore of the lake—from Houghton if I remember rightly—in the summer of 1871. We went down by the Manitoba, Captain Symes, on November 30 and left the survey on January 24 on the return trip. Our route was around the north shore, and the transportation of our baggage, etc., was by toboggans made in the bush before starting. We reached Port Arthur on February 17. We then learned for the first time that we had been making a survey of lands upon which valuable deposits of tin ore had been discovered the previous season. In those booming days of sur-

White River.

Prof. Willmott, who ran a micrometer survey from White River to the mouth of Dog river, reports as follows :

" Leaving Dr. Coleman at Heron Bay, Mr. George and myself proceeded by train to White River, where supplies were purchased. Two Indians, Alexander Matchinini and William Pansway, were engaged as canoemen and proved very satisfactory. By the kindness of Mr. W. H. McDougall I was provided with a bark canoe, tent, extra compass and some of the necessities of a camp, which were returned by the canoemen two weeks later.

White River Station.

" White River is a divisional point on the Canadian Pacific Railway, 304 miles west of Sudbury. It is a village of about 300, dependent almost entirely on the railway. Two other industries are the collection and shipment of $10,000 worth of fur yearly, and the manufacture of cold weather statistics. White River enjoys the unenviable reputation of being the coldest place in Ontario reporting to the Meteorological Department. Nevertheless the observer finds farming profitable and I noticed that the blueberries were fully two weeks earlier than on lake Superior, 40 miles south and several hundred feet lower.

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veying and taking up mining claims many of the operators thought it necessary to conduct their operations with as much secrecy as possible, and for a member of a survey party to have asked any questions as to the exact destination of the expedition, or the nature of the mineral discovery, would have been resented as being very ill bred. Homer Pennock, also of the north shore, and a man named Johnston posed as the discoverers of the tin; whilst Northrup and Wood were the vendors, and sold the discovery to a syndicate of Detroit mining men, who organized a company, paying Northrup's crowd part in cash and part in stock, besides buying the land from the Government and paying the survey and all other expenses. During the winter the Northrup party [illegible] posed of their stock, much of it in Boston, I believe, and other eastern cities. In the spring the writer and Mr. [illegible] went back to Homer and made the survey of the above [illegible] and of some additional [illegible] along the east boundary of the first survey. The Detroit company were now in charge [illegible] of Captain [illegible] [illegible] Pennock came to the [illegible] camp, [illegible] the survey the writer returned with his party to Port Arthur. Later the report came that the tin vein or veins had been visited and inspected by Captain Harris of Ontonagan, Mich., the expert appointed by the syndicate to make the examination, and that his report was favorable; it was all right. A good deal of stock was sold on the strength of Harris' report, for he was a man of undoubted integrity, a Cornishman who knew tin ore when he saw it, and who had had a very extended career in copper mining on the south shore of Lake Superior. The vein was seen on the east side of [illegible] cove and also crossing the point of land to the west side of that sheet of water.

Early in the spring of 187[illegible] [illegible]

Ascent of White River.

"Our course lay east for two miles along the railway track, which here crosses the White river a number of times. The river is rapid, so that we found it easier to transport our provisions along the track to a point one-eighth of a mile west of mile board 744. Here we began a track survey with micrometer telescope and compass which was carried to the mouth of Dog river.

"The route begins with a portage nearly half a mile long over Laurentian gneiss. Then we launched our canoes in the White river and ascended it in an almost due south direction for a distance of seven miles. Two more portages had to be made, one of 600 feet with a rise in the river of 12 feet; the other half a mile long around two rapids where the river rises 13 feet. At the south end of this portage the rock is a gneiss with Keewatin-like inclusions, both cut by dikes. Two miles and a quarter south similar Keewatin-like inclusions were noticed in the gneiss.

"Seven and a half miles south of the railway a sluggish stream enters from the south. The White river itself has little current except at the rapids mentioned. For much of the distance it flows in a marsh with rocky hills one-quarter to one-half mile apart. From this point to the railway I made the total fall 65 feet by aneroid. The hills are low and burnt, and thickly strewn with boulders, mostly granitic.

Pokay Lake.

"One-fourth of a mile up the tributary stream, Pokay lake was reached. Its extreme length north and south is three and a half miles, its greatest width one and a half. On its western side another small band of Keewatin included in gray gneiss was seen. The shores of the lake on the north and east consist of burnt tamarac and spruce swamps; to the south and west are some hills.

Dog River.

On the Mountain Portage

"From the extreme south of Pokay lake a portage nearly a mile and a half long leads over the height of land to the headwaters of the Dog river. The trail, known locally as the Mountain portage, is at its summit 300 feet above Pokay lake. The path is steep and stony in places and burnt logs are too frequent for comfort. The lake to the southeast of the portage is known to the Indians as Clear lake, but as this name is becoming too common for convenience I have designated it as McMaster lake. It is about a mile and a half long and surrounded by spruce. This lake, the headwaters of the Dog river, is 786 feet above lake Superior and 145 feet above the White river at the C. P. R. crossing at mile board 744. An unnavigable creek runs from the northern end into University lake, two-thirds of a mile to the east. The trail is level and dry and may be crossed in fifteen minutes. One mile and a half southeast of University lake a marshy channel may be followed by which half a mile of paddling may be avoided. From University lake to Obatonga lake, a distance of five miles, the river meanders through a marsh with little current. Occasional rocky islets consist of gray gneiss.

Obatonga Lake.

"Obatonga or Sand-bar lake is a little over three miles in length from northeast to southwest and from a half to three-quarters of a mile wide. It receives its name from the sandy peninsula and island which nearly divide it in two. To the north it is surrounded by low rounded hills of gray gneiss. A portage route leads from the north end to Amyot on the C. P. R. At the outlet is a small rapid where the river descends two feet. Thirty feet above is a small plain with well-rounded gravel which can hardly have been made by the river.

Knife Lake and George Lake.

"Three-quarters of a mile below is Knife lake, a fine body of water a mile and a half in diameter. About the middle of the western side on a small island there is an inclusion of green schist striking 100°. A mile and three-quarters south of this the true contact of the Laurentian and Huronian was found. The stream on leaving Knife lake is rapid for a mile, falling 33 feet. To avoid this a short portage was made to the east into lake George, a shallow sheet of clear water three-quarters of a mile long. Half way down it the gneiss becomes granitoid and then appears in eruptive contact with the green schists which strike 85° to 90°. Twenty-five miles to the east, on the Magpie river at a similar contact, the strike of the schists is 88° and this is probably a continuation of that band [21].

McDougall's Mining Claim on Dog River.

"An unused trail of one-sixth of a mile leads from lake George to the river. Numerous quartz seams of small size were seen in the schists for some distance. Two miles and a half below, a portage of one-third of a mile occurs. A half mile below is a gold prospect belonging to W. H. McDougall of White River. A small amount of stripping has been done, exposing a bed of solid quartzite 15 feet wide and perhaps as much more mixed with schist. The quartz is rather glassy, but contains a considerable amount of pyrites, which on the surface has weathered to hematite. An altered quartz porphyry adjoins the chlorite schist on the north, the strike being 90°. A short distance below a much stretched schist conglomerate occurs. South of this is a sheared quartz poryphry in contact with a hornblende schist. A prospecting pit in the latter proved of no value, the quartz seams soon disappearing. A mile and three-quarters below McDougall's camp a stream comes in from the north. On a lake at the head Mr. McDougall informed me that he had found iron. In the absence of a guide it seemed useless for us to attempt to find it.

A difficult reach of River

"From here to lake Superior the Dog river is not now travelled, even the Indians avoiding it on account of its numerous rapids. So far as I could learn [illegible] one white man had ever been down it to its mouth—a C. P. R. engineer [illegible] investigated it as a possible route [illegible] interior. Seven miles [illegible] McDougall's [illegible] an old Indian route [illegible] chain of lakes [illegible]. Even this has fallen [illegible] this point we had to make [illegible] portage paths, and they were [illegible] few hundred yards there was a [illegible] of water filled with [illegible] which made it impossible [illegible] down with safety. The stream [illegible] crooked and [illegible] shortened [illegible] a few [illegible] falls have been [illegible].

"A short distance [illegible] to Superior gray gneiss [illegible] observed, though the exact contact was passed. Over two miles below pieces of Keewatin green schists were found included in the gneiss, so the contact is doubtless an eruptive one. A little farther on the river has excavated a narrow gorge in a band of included schist, gneiss forming both banks.

Pot Holes.

"Numerous pot holes have been made by this turbulent stream. One measured 10 feet by 12, and was six feet deep. A more striking one was perfectly round, 11 feet in diameter and 23 feet deep. A flat rock just at water level formed three-fourths of the circumference.

Lower stretch of Dog River

"Ten miles from lake Superior the water of the lake was visible from a hill top. Eight miles north of Superior a very considerable stream comes in from the east. One mile and a half to the southeast a very schistose gneiss [illegible] its eruptive contact with the green schists. Both are cut at right angles by a [illegible] of greenstone 10 feet wide. Near the contact are a number of twisted quartz veins [illegible] 15 inches wide. A mile and a half [illegible] contact large felspar crystals were [illegible] the schist, which dips 45 north. [illegible] were numerous quartz veins, one three feet wide. Two miles from the mouth Dog river flows through a narrow gorge [illegible] feet [illegible]

[illegible]

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[21] Bureau of Mines [illegible]

Swallow river and make another attempt to climb Tip Top mountain, probably the highest point in the Province of Ontario. At the mouth of Swallow river a small outcrop of conglomerate, very like the basal conglomerate of the Kewenawan was found, the most northerly we observed. It filled a small ravine in granite and contained boulders of the same rock. It looks as if lake Superior is now just finishing the work of exposing the ancient Pre-Cambrian shores by eating away all the softer rocks, leaving the Archaean basin as it was in long past days. There is a beautiful fall less than a mile up Swallow river, where the river springs 80 feet in almost a single leap over a wall of granite. As the river is shallow and full of rapids, my guide, Toussaint, thought it better to go on foot to the mountain, situated on the chart about 10 miles to the north.

Ascent of Tip Top Mountain.

Our path, which was crooked and often hard even for an Indian to follow, led over rough hills and valleys for about seven miles, when we once more touched the shore of Swallow river. Our course was considerably east of north. Here a night camp was made by one of the Indians, while the rest of us went north about five miles over rougher country than before. The mountain has a dome-shaped top and consists of Laurentian granitoid gneiss, with dikes of pegmatite and also diabase. A large mass of fine grained diabase forms the highest point. Some massive flat stones mounted on others in a way suggesting a rude altar probably served as bases for instruments during the American hydrographic survey, when this was one of the stations. The surrounding valleys are covered with thick forest growth, and most of the neighboring summits are covered with fair sized trees to the top, except where precipices are too steep to give them foothold ; but the summit of Tip Top is covered with bushes only, or perhaps one should say with very stunted trees, none rising above 20 feet. The kinds observed were spruce, birch and mountain ash. It seems as if the unchecked violence of the wind and storms must cause the stunting, for the height, as found by aneroid checked for change of barometer, is only 1,525 feet above lake Superior, or 2,125 above sea level, far below tree line for
mountains at this latitude. It can har
due to cold, for blueberries were much
on top of the mountain than on the lake
1,500 feet below. The view from the
mit is fine, though not so fine as that
lower points ascended near the lake,
the sharp bare cliffs are so effective.

Rolling Hills and Spruce Forests.

The general appearance is of rolling
with a few slopes of bare rock, the onl
precipices to be seen lying no
Spruce harbor several miles
There is very little burnt co
within the field of view, but little o
forest is of value except spruce for pulp
of which there appeared to be large quan
No plains or terraces of cultivable land
be seen except a few small beaver mea
nor were any bodies of water disclosed
three ponds, and the wide expanse o
Superior seven miles to the west. It is
ful if this region will ever support a p
tion beyond a few fishing stations and a
or two working up pulpwood near so
the large waterfalls.

Caribou.

A young caribou was seen on the
camp, and these animals appear to be
mon. My Indians say the
"moss," the gray arborescent
of the rocks ; various herbs, some of
they pointed out, and mud ! They cer
paw the moss away and leave bare s
probably not for the earth but for ro
bulbs of small lily-like plants to be seen
ing about. They are said not to eat
and certainly the rank grass of the
meadows was untouched.

Reunion of the Exploration Parties.

Paying off the two Indians, who
their bark canoe with gull squabs from
off the harbor, we parted com
they to paddle along shore to
and Stephen and myself to
eastwards in the Peterborough to the
of the Pucaswa, where we expected to
the fishing boat. Seeing no signs of th
at that point, we pushed on towards
harbor, meeting our friends half wa
finding that all had gone well with the
our supplies for the last two or three da
got down to flour and the trout to be
in every stream, we were not sorry to
better rations.

It was too late in the day to sail over to Quebec harbor on Michipicoton island, our destination, so we chose a Sunday's camp in a little bay east of Pucaswa.

A remnant of Keweenawan Conglomerates.

The rocks at this camp consist of schist conglomerate, forming a fringe along shore for 1½ miles and including several small islands; and felsite or porphyrite on the hills inland, where the country to the north is very rugged. A small patch of Keweenawan conglomerate shows on a large island near by, one of many instances on this shore where a remnant of these easily attacked rocks has been preserved in a fissure of the older, harder rocks.

Caribou Island.

During our trips across country, Mr. Coulthard in the Caribou had visited Caribou island, far south of Michipicoton island. He found the rock to be brown St. Mary's sandstone, like all the other islands in the southeastern part of lake Superior. The island is low and covered with scrubby trees, mostly spruce. A lighthouse and fishing station, occupied only in the summer, are on a smaller island just to the south of Caribou island, one of the loneliest inhabited spots on lake Superior.

Michipicoton Island.

Features of the Island.

With the exception of St. Ignace, which protects Nipigon bay, Michipicoton island is the largest of the innumerable Canadian islands in lake Superior. It lies about ten miles due south of Pilot harbor, but its only inhabited port is Quebec harbor on the south side; and in spite of its indented shores as shown on the chart, it seems not to possess many well sheltered harbors. The island has long been known to be copper-bearing, and its rocks and mines are briefly described in the Geology of Canada[23]; where the whole island is shown to consist of Upper Copper-bearing rocks, i.e. Keweenawan, consisting mainly of various kinds of trap and sandstone or conglomerate, the whole footing up in thickness to not less than 12,000 feet.

Philipps and Quebec Mines.

We landed on the northwest side of the island, visiting the two mines once operated there, the Philipps and the Quebec mines. The shaft of the Philipps mine was found to be nearly full of water and no ore was to be seen on the dumps, only weathered amygdaloids. The Quebec mine two or three miles to the west had just been pumped out by Mr. Cozens of Sault Ste. Marie, who had control of it, that it might be examined. It has since been reported that the mine is sold.[24] We were however too late to meet the party which had unwatered and examined the mine. There are 15 or more well built houses for one purpose or another besides three shaft-houses and a large mill, the latter provided with a concentrating plant. There are two curious caves to the west of the camp, one over the other, the lower one being used as a powder house. This cave is 26 paces long, 12 wide and 15 feet high near the mouth, and a natural arch or bridge spans the space before the entrance. Its floor is about 15 feet above the lake, which lies only a few yards away; and the cave seems due to wave action at a time when the water stood higher than now. The second cave, 40 or 50 feet above the lake, is evidently an old sea cave also. The rock is dark diabase.

Lake Terraces.

A fine set of terraces may be seen from the lake as one approaches Michipicoton island at the Quebec mine, and a good road leads across the island to the south shore passing over them. We measur-

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[23] 1863, p. 81 and also pp. 703-4. See also Macfarlane, ibid, 1863-66, p. 135, etc.

[24] Two specimens of ore from Michipicoton island, sent by Mr. Cozens to the Director of the Bureau of Mines and forwarded to me for examination, are good examples of the copper-bearing conglomerates of the Keweenawan of lake Superior. They are rather dark purplish gray rocks, consisting of pebbles and smaller fragments of felsite, quartzless porphyry and less often quartz porphyry, cemented by a small amount of a soft white or greenish substance, partly calcite and partly a zeolite, so far as can be determined without blow-pipe tests. Chalcedony approaching agate in structure occurs in one specimen. The most interesting mineral however is the native copper, which is untarnished and forms irregular plates and masses between the small pebbles of the conglomerate, and hence occupies the place of part of the cement of the rock. It is plentiful enough to hold together shattered fragments of the stone, and in these specimens is evidently present in quantities sufficient to make the rock a most valuable copper ore. In general appearance the specimens are of precisely the type of the copper conglomerate so extensively mined in northern Michigan, and as they occur in rocks of the same formation there is reason to hope that mining operations will disclose deposits of much importance.

Quebec Harbor.

ed four prominent ones at levels of 61, 191, 233 and 288 feet respectively; many less marked water levels occur also. On the 233-foot terrace there is a nice farmhouse and barn, now deserted. The soil looks rather poor in most parts. The road passes a lake of considerable size at the level of the farm, and another one at about the level of the next lower terrace. The region around the Quebec mine is very pretty, with a hill 900 feet high as a background and the terraces partly wooded but mainly cleared, rising up from the water. The road running south from the Quebec mine is rather grown up with bushes, part of the way being now little used. It comes out at the south shore where a black eruptive glass or pitchstone occurs, and also amygdaloids with some fairly good agates. Here the road turns east along the shore to Quebec harbor, a land-locked bay with a lighthouse at its mouth. There are several houses on the shore of the bay, but only two or three families of fishermen and the light keeper live there at present. There is a large clearing with a good crop of timothy hay just being cut on August 2.

Volcanic Rocks.

Cruising round the island toward the east, much red quartz and also quartzless porphyry are seen, whole bays having their pebble beaches and shore cliffs of this richly colored rock. On other bays the rock is a black diabase, amygdaloid or pitchstone, forming beaches as well as rock walls, and giving a very somber effect. The rocks obtained will be described in another part of this report. On many of the beaches agate pebbles are found, and veins of quartz, chalcedony and agate occur in the diabase.

The island is a very interesting one, not only on account of the varied volcanic rocks which chiefly compose it, but also because of its rugged and picturesque shore line and mountainous interior, dotted with many charming little lakes. At present, however, its only regular communication with the mainland is by means of an American fishing steamer.

Michipicoton Mining District.

As Prof. Willmott reported on this district last year and is familiar with its general features, it has been thought best that he should prepare the following report of our work in the region during the past summer:

Schist Conglomerate and Granite.

Tracing the Conglomerate Belt.

"From the mouth of the Doré the schist conglomerate was traced for four miles to the east, to a point one mile east of Gros Cap wharf and 200 yards inland. The strike is very uniform, never varying more than 10° from 80°. The continuation of this course for four and a half miles farther would cross the Magpie river three miles from its mouth, and here a conglomerate was noticed last year. Two and a half miles to the northeast a similar conglomerate with a strike of 75° is exposed at the northwest angle of Wawa lake. That these three occurrences are part of one band is very probable, although the one strike recorded for the rock on the Magpie (148°) is far from the general direction."

Eruptive Granite.

"At the second portage up the Magpie the boss of eruptive granite was again examined. It is very coarse-grained and consists of round blebs of quartz in a red felspar, with almost no mica or hornblende. In the river gorge, at the foot of the rapids, is a section showing 90 feet of green schists curving in a gentle anticline over a boss of the granite 30 feet in height. At the head of the rapid both sides of the stream are granite and continue so for half a mile upwards, when a banded schist is met. The schist is in part felsite, carries much pyrite, and seems in places to contain pebbles obliterated by being rolled out like those around Heron bay. The immediate contact with the granite was not found. A few hundred yards up stream the strike increases to 170°. About a mile above is the conglomerate noticed last year and striking 148°.

"One-quarter of a mile below the portage a small scrap of conglomerate was found striking 180° and containing pebbles of felsite and quartz porphyry. Apparently this boss of granite has come up through the schist conglomerate, dislocating a piece to the south and disturbing the strike of both.

"All the islands south of the Doré consist of conglomerate except the most south-

West of Gros Cap.

eastern one, where a small scrap of chlorite schist was found on the south side. On an island just to the north-east of this a dike of greenstone 20 feet wide has pierced the conglomerate, following the strike.

"On the mainland adjoining the conglomerate to the south is a chlorite schist. This is followed by a narrow band of quartz porphyry and this by an agglomerate rock. The same rock occurs just east of the wharf, where it is a compact green rock enclosing lenticular pieces which only appear distinct on the weathered surface.

Hematite Iron.

Early Workings at Gros Cap.

"South of the agglomerate on the west shore of Gros Cap is a band of chlorite schist which includes several narrow bands of quartzite. The extreme southwest of the cape is a diabase schist. Associated with the quartzites are considerable bodies of hematite and a number of test pits have been sunk on both sides of the cape. The most extensive workings were on the southeast coast, where the old dump may still be seen, although the trench is overgrown and the shaft filled with water. A description of the rocks was given by Macfarlane in his report of 1866 when operations were going on, and little can be added now when everything is overgrown with moss or covered by debris."

"The ore as found on the dump consists of compact hematite associated in layers with quartzite. A specimen analysed by Sterry Hunt[25] yielded:

Ferric oxide	86.80
Insoluble residue	12.75
Phosphorus	trace
Sulphur	.092
	99.642

Macfarlane gives the thickness of the ore bands as one-half to four or five inches, and the maximum thickness of the deposit at 60 feet. This was as he saw the early workings on the surface. Captain William Grierson, who sank a shaft to the depth of 64 feet (on the dip of the bed) in the winter of 1867 informed me that at the bottom the quartzite disappeared and that there was solid ore for the full width of the shaft, seven feet. No crosscut was made. Water came in the shaft and had to be baled out. All hoisting was done by hand. J. W. Johnston of Detroit was owner.

"The ore on the dump is all interbedded with quartzite, very little being solid hematite. The part of the bed which seems to have been worth working was about 25 feet wide. Two open cuts were made on the bed, each about 100 feet long, one near the level of the lake, the other a continuation of the first but higher up the hill. From the northern end of the upper cut the shaft was sunk. The vein bears about 135° and dips 45° to the southwest. On the continuation of this strike on the south side of Michipicoton bay I have noticed small seams of hematite in the schists, but evidently resulting from iron pyrites found accompanying them.

A Sandstone Band.

"Just northeast of the iron deposit is an irregular bed of sandstone a few inches wide enclosed in the chlorite schist. The sandstone is in places largely magnetite, in other spots a nearly pure sandstone and very friable. It has been so crushed and contorted that in places the chlorite schist seems to contain pebbles of sandstone unconnected with their neighbors. This crushed sandstone may be compared with that described by Dr. Coleman as occurring one mile west of Fort Frances. Some boulders from the conglomerate at the mouth of the Doré are exactly like this sandstone, and may have been derived from it. It is worthy of note that the sandstone is on the lake Superior side of the conglomerate, and is now dipping from it. The same chlorite schist encloses within a few hundred feet a bed of friable sandstone with magnetite and a bed of quartzite with hematite.

Gold Mines at Wawa Lake.

Jubilee Mine.

"One day was spent by Dr. Coleman and myself in a trip from Michipicoton Post to Wawa lake and some gold properties to the south of it. At the Jubilee mine on locations 38 and 75 we found Mr. A. Douglas in charge for the Great Northern Mining Exploration and Development Company. The vein, which is a bedded one, has been traced for a mile with a strike of about 20°. The shaft was down 60 feet following the dip of the vein, that is about 45° east. According to Mr. Douglas the vein varies in width from 7½ to 10 feet. At the surface considerable free gold was found. Towards the bottom of the shaft some of the adjoining gneissoid rock becomes mixed with the quartz.

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[25] Rep. Geol. Sur. 1866-9.

Diamond Jubilee Mine.

"The Diamond Jubilee mine is on location 92, a short distance southeast. Messrs. Tisdale and Boyd are owners. Considerable work has been done in stripping the veins, of which several have been found carrying free gold. Their surface workings were about at the level of a small lake, and to keep their prospecting pits dry it was found necessary to lower the level of the lake by blasting out the rocky barrier at its outlet. The veins are bedded in felsite or sericite schist, striking 25° and dipping 70° east. Eruptive gneiss occurs to the north and to the southeast of the workings. At the deepest pit, 12 or 14 feet, near the lake, the quartz looks quartzitic, is bluish white in color and carries pyrite, pyrrhotite, chalcopyrite, a gray carbonate and free gold. An assay of a sample of this ore taken by ourselves gave 5.03 oz. per ton. To the south a vein of quartz occurs between granite on the west and chlorite schist on the east.

The Ward and Mackie Properties.

"On the Ward property just south of this considerable prospecting has been done. Six openings have been made, the deepest being 15 feet, and some stripping has been done. The contact of the gray gneiss and green schist is well-shown on the long lake on which the camp is situated.

"At the Mackie property on Wawa lake nothing has been done since the last report beyond the erection of two log houses. At Wawa city several frame buildings had been erected and others were being built.

Defining Rock Areas.

The Contact of Laurentian and Huronian Formations.

"On the map published last year the contact of the Laurentian and Huronian south of Wawa lake was settled by an excursion up the Fine Sand river from the Michipicoton. After crossing a small band of Huronian about a quarter of a mile in width, what appeared to be the main mass was met about one-quarter of a mile south of lake Leroy. The red granite at the second portage up the Magpie and the granite porphyries to the south of Wawa lake were thought to be later eruptives. It is now evident that the rocks southeast of Wawa are mainly granites or gneisses enclosing small scraps only of Huronian. It is moreover probable that the rock on the Magpie though differing in structure and composition belongs with these granites. This being so, the boundary of the two formations runs from the long portage of the Michipicoton to the second portage up the Magpie, and thence northeast along the axis of Wawa lake to a point west of Hawk lake. Included in this area, now transferred from the Huronian to the Laurentian, are a number of Huronian masses which were doubtless torn off from the main mass by the eruptive granite.

Extent of the Schist Conglomerate Band.

"One mile and a half south of the high falls of the Michipicoton a schist conglomerate was found a year ago. Apparently this is a continuation of the band met with on the Magpie nearly eight miles to the northwest. From here the band has been traced west for eight miles to the Doré, and from there a succession of scraps along the shore probably indicates its continuance for 11 miles to near the mouth of Dog river. Two miles up the latter stream it is found at Denison falls, a total length of 29 miles. For two-thirds of the distance an eruptive granite is in contact with the conglomerate."

General Features of the North Shore.

Impressions of the Superior North Shore.

Looked at as a whole the north shore of lake Superior from the Sault Ste. Marie to Peninsula impresses one by the magnificence of its scenery, often wild, rugged and mountainous; by the number and variety of its harbors, which are however generally small; by the multitude and picturesqueness of its islands; by the widespread ancient beaches, and by the general barrenness and desolation of the land.

Leaving out perhaps 100 Indians, our captain estimated that on the whole shore line

The Population and the Fishing Industry.

of not less than 320 miles there are only about 350 people, of whom a large number are not permanent residents, but go to the "Soo" or elsewhere in the winter. If we commence the count at Point Mamainse, 45 miles from the Sault, we have only about 150 people scattered along a shore of 275 miles, and more than half of them are away in winter. Finally in the 70 miles from Ganley's harbor north of the eastern end of Michipicoton island to the mouth of Pic river there was not an inhabitant, white or red, when we passed up last summer. The men frequenting the shore at present are mainly fishermen in the employ of one or two large companies, their catch consisting chiefly of delicious whitefish and of salmon trout. The fish are taken partly in pound nets near the mouths of the rivers, and partly in gill nets set in fairly deep water in the open lake. Sayers, our captain, an experienced fisherman, says that nets are seldom set in water deeper than 100 fathoms (600 feet) because at a greater depth the cedar floats become water-soaked by the pressure and no longer keep the net upright. The fish caught at great depths are mainly very fat and large salmon trout. While the usual depth is between 10 and 100 fathoms, they sometimes, off Caribou island for instance, get one end of their net down even to 160 fathoms (960 feet). This is not far from the greatest recorded depth of soundings in lake Superior, 1,008 feet. Most of the rivers and inland lakes contain splendid trout, some of them true brook trout.

Resources of the Mainland.

Northwest of Mamainse there is very little land suitable for cultivation so far as our observations go, though small areas may be found inland ; and the only promising resources known are found in the water powers, the spruce forests and the copper and gold mines. The shore climate is generally cool, even in the warmest months demanding heavy clothing for comfort ; owing to the vast body of cold water in the lake. Inland a few miles however the weather may be very hot even though hundreds of feet higher up. This difference is well shown in the ripening of wild fruit such as strawberries, blueberries and bilberries (or saskatoons) which we found very plentiful and quite ripe on July 23, 700 feet above the lake and 20 miles north of it ; but still green on the hills at the mouth of the Pucaswa several days later. The coolness of the climate does not prevent the black flies, sandflies and mosquitoes from swarming in early and middle summer all along the shore.

The power of Wave Action.

To one accustomed only to the wave action of comparatively small lakes, like Ontario, the power of the waves on exposed shores of lake Superior is very surprising. Boulders a foot in diameter are rolled by the waves up and down beaches which rise to a height of 20 feet above the normal water level, and are as beautifully rounded as the pebbles on lake Ontario beaches. The isolated islets and rugged stacks along the shores and the wave-cut caverns testify to the same thing.

The formation of well-rounded pebbles is very quickly performed in the case of soft rocks. Calcite fragments used in the crib-work protecting Silver Islet were found perfectly rounded ten years after the mine ceased working.

The elevated beaches so common on the north shore up to 300 or 400 feet above the present lake have their pebbles and boulders as well shaped as those on the beach of today. The question of these old lake levels will be discussed however in another section of the report.

On the whole the shores of lake Superior much resemble stormy sea coasts, the main difference being the absence of appreciable tides. Tides of a few inches magnitude do exist however, as well as irregular risings and fallings of the water (seiches) due to varying barometric pressure on different parts of the lake.

Near Michipicoton Post.

Development operations.

A short stay was made at Michipicoton Post on our return from the island of the same name ; and the Collingwood skiff and its crew, after serving us well during the summer, returned to Sault Ste. Marie ; while we made a brief examination of the Wawa gold region. As the geology of this region was partly worked out by Prof. Willmott last year and published in his report on the Michipicoton Mining Division,[26] and has been further described by him in foregoing pages it is unnecessary to make further reference to it here. We found a considerable amount of building going on both near the Post on the river and at the new town on Wawa lake. A good deal of prospecting work also was being carried out on a number of properties; but none of them had advanced far enough to be called mines. Several of them looked promising, but all require further development before their real value can be determined. British Columbia and the Klondike had attracted the attention of many away from the less dazzling prospects of a quartz mining region, but those who remained seemed hopeful and satisfied as to the prospects of the country around Wawa.

After visiting the mines we took the steamer Telegram at Little Gros Cap, to which a steam ferry now runs from the mouth of Michipicoton river, and returned to Sault Ste. Marie.

Thessalon District.

Huronian rocks along the Lake Shore.

We now went by rail to Thessalon in order to complete the examination of the mines to the north of that town, and on the way spent a few hours examining the Huronian rocks along the railway between Bruce Mines and the harbor of Thessalon. A mile east of Bruce Mines we found a band of limestone, striking east and west and with a vertical dip. Half a mile beyond there was quartzite with pebbles of black chert, lying apparently horizontal; the latter rock, perhaps Upper Huronian, resting uncomformably on the upturned Lower Huronian. At Thessalon there are, as noted by Logan, amygdaloidal diabases belonging to the Huronian.

Cheney Copper Mine.

On the Mississaga River.

From Thessalon we drove northeast about 20 miles to the Cheney copper mine on the Mississaga river. The road leads first over level plains of clay or silt, old lake deposits with good farming land, now pretty well cleared and cultivated.
Then come hills with some rock ex
especially Huronian quartzites and re
ite, followed by level terraces mainly
and gravel with rather light soil but
well settled. Finally a hill of slate co
erate rising 490 feet above lake Huro
be ascended and then descended to rea
mine, which lies near a picturesque wa
on the shore of the river. The road
whole is very good, the mining co
having spent $1,000 in putting the
part of it in good shape.

Extent of Development Work.

It was known many years ago that
ores existed up the Mississaga river, v
localities where small ou
occur being mentioned by M
in the Geological Survey
for 1858[27]; and the present locati
taken up in 1864 by Mr. Borron, for
Ray of Indiana. It was then turned o
a Mr. Drake, who formed a company o
dicate to work the location. The me
of the syndicate are mostly of New
State, and the property is held in the
of Mr. J. A. Powers of Lansingburg
Troy, N.Y., Mr. F. A. Cheney being m
ing director. The latter gentleman de
our warmest thanks for the hosp
afforded us and for the information gi
to the mine.

The earlier company had sunk an 8
shaft, but the present company, which
hold of the work more than a year ag
straightened the shaft and sunk it to 16
besides drifting at the first level 100 f
the northwest and 20 feet to the southe

The vein was three feet wide on th
face, runs northwest and southeast th
a country rock of slate conglomerate, a
said to have been traced 2¼ miles. It w
as it goes down and changes its dip fr
to the northeast on the surface to abou
The foot wall is very distinct all the
down, but in the lower part the vein m
is much mixed with rock.

For the first 100 feet there was good
chiefly chalcocite (glance), at one poi
that level forming a solid ore body as
as 40 inches wide. With the chalcoc
little bornite and copper pyrites are as

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[26] Bur. Mines, 1897, pp. 184-206.

[27] Rep. Progress, 1858, p. 225.

ted. It is found that reddish or rusty quartz carries no ore, but that white quartz is productive. Unfortunately very little chalcocite has been found below the 100-foot level.

Between 65 and 73 feet in depth 8,037 lb. of glance was obtained by hand picking ; and in all a car load of good ore, amounting to 20 tons and 400 lb., has been shipped east to the Orford company. The select ore runs from 22 to 40 per cent. of copper, the poorer ore not being treated at present. It was intended last fall to stope out and ship the rest of the rich ore disclosed above the 100-foot level. It costs $4.50 per ton to team the ore to the station, and $6 as freight to the east. If it should seem wise to put up a mill for the treatment of the ore there are fine falls on the river close by. The nearest, called the Baboon Falls, from the appearance of a baboon's head in the rocks, is close at hand and has a drop of 20 feet. Not far off there is an upper fall of 34 feet.

At the time of our visit 16 or 17 men were employed under Wm. Blewett as mining captain ; and the buildings and equipment seemed adequate for the work on hand.

The Mississaga Placers.

Exploiting a Lake Terrace for Gold.

Some miles down the river from the Cheney copper mine there was an attempt at placer mining a year or two ago. On our way back to Thessalon, by round-about and bad roads, we visited the placer on Mr. James Ralph's farm, the south half of lot 3, con. 1, in Wells township. At this point a sand and gravel terrace is cut by the Mississaga river, showing a face of about 40 feet. Sluices had been arranged by Mr. Wilson of Toronto to wash the sands, a water supply being obtained from the hillside some hundreds of yards from the river. Near the foot of the cutting coarse brown sands cemented by brown oxide of iron were supposed to carry the largest quantity of gold. Samples of the yellowish sand above and of the brown cemented sand were taken with care, the amount making a number of pounds in all. Pan tests and also assays of both kinds of sand, made in the laboratories of the School of Practical Science, Toronto, yielded traces of gold. but only a few cents per ton. It seems very doubtful therefore if the placer ground will prove of value. If it should prove workable, the quantity of sand in this old beach deposit or terrace is very great, and might give rise to very important bench diggings.

It should be understood however that the sand and gravel deposits along all the rivers of the north shore of lakes Huron and Superior are lake deposits, many of them deltas, formed when the water stood at a higher level than now, and not ordinary river deposits. Most placer mines are on the gravels found in river valleys, ancient or modern. A few rather unimportant placers are sea-shore deposits ; but few or none are known in true lake beaches.

So far as our information goes bed rock has never been reached on the Mississaga river, but whether this would prove any richer in gold than any other layer in an old lake deposit is doubtful.

Goulais Bay District.

Further study of the Huronian Rocks.

On August 11 Prof. Willmott and I set out for Goulais bay to complete our study of the Huronian rocks, while Messrs. George and Coulthard started for home, taking the Sudbury mining region on the way. Goulais bay may be reached by water, but there is no connection by roadwith the settlement inland along the river valley, so we decided to drive from the Sault Ste. Marie.

A Mountain Road to Goulais River.

The road leads west into the township of Korah, and then turns north till it reaches the river. The first five or six miles are excellent, largely over old lake terraces, the higher ones of gravel. On the northward part of the 20 miles journey, however, the country becomes mountainous and the road very stony and bad, the highest point as determined by aneroid being 800 feet above the Sault. The road climbs terrace after terrace, at first of clay, forming good farming land, now mostly occupied ; then of sand and gravel ; and at last crosses solid rock, more or less covered with boulder clay. Descending from the highest point one reverses the succession of terraces until the flat plain of Goulais river is reached. Here the soil seems fair though rather sandy, and a considerable number of farms are o

The rocks observed along the way are mostly Laurentian gneiss. The most comfortable stopping place in the settlement is at the house of Mr. McAu'ey, the postmaster, which is several miles north of the bridge crossing the crooked river, just at the southeast corner of Haviland township, between Goulais and Batchawana bays. A somewhat steep and stony road leads north and then northwest from this point to the settlement on the western side of Batchawana bay.

Formations on Goulais River.

The ground rises as terraces in McAuley's neighbourhood, affording level stretches of good but sometimes stony clay soil, now largely divided into farms and partly under cultivation. The rock observed here and to the north is Huronian, partly felsite in beds alternating with slate, partly Logan's slate conglomerate with eruptive masses of syenite or gneiss breaking through it. Some of the slate is very cleavable and might be of value for roofing.

King of the Mountains.

The highest point in the settlement, called rather absurdly the "King of all the Mountains," was ascended and found by aneroid to rise 1,320 feet above lake Superior, or 1920 above the sea. It was used as a triangulation station by the U. S. Hydrographic Survey, and remains of their tripod are still to be seen on its highest point. The rock of which it is composed is quartzite, the hardest and most resistant of the region. On the side fronting the settlement it is so steep as to be almost unscaleable, but a blazed path winding round behind the mountain top gives an easy ascent.

From the summit the view is very fine, more variety of surface being in sight than from Tip Top mountain, though the latter is about 200 feet higher. Some miles to the northeast one can see a mountain which looks distinctly higher than the King of all the Mountains, and it is possible that this may even surpass Tip Top in height. All round the peak there are forest covered hills with here and there bare slopes of rock, while in the valley the grass and grain fields about 1,000 feet below look like the squares of a checkerboard. The deep bays indenting this part of the shore of lake Superior show as splendid expanses of blue water.

The Settlement.

It was surprising to find so much
land in this isolated settlement, though
woodland still remains unto
Grain of various kinds was
ing on August 12, and the crops
well, though there is no object in
more grain than can be consumed
spot; since the terrible mountain road
Sault prohibits teaming it out at a prof
the lumbermen, on whom the settlem
largely depended in former days for it
ket, have practically finished their w
the region. The settlers are hoping t
a new Government road cut to the Sau
only much shorter because more dire
also avoiding the mountain now to be c
This would help them greatly in reg
markets, and would probably open u
fair land not yet settled upon. A
of about six or eight miles, cut to the l
place of the fishing station on the poi
of Goulais bay, would also give them an
during the summer.

The forest of the region is mainl
wood, such as maple and black birch
drier and richer soils ; and young appl
in fruit at McAuley's looked very t
showing that the climate is not ba
present however the settlement d
mainly on its stock as a source of i
If the copper mines of Mamainse and
picoton island are developed with
there should be an excellent market f
people of the settlement almost at thei
doors.

Pleistocene Geology.

A Feature of Terraces and Old Lake Beaches.

The wonderful series of terraces a
lake beaches displayed in the region
over last summer has at
much attention from the d
Agassiz's journey to lake S
to the present. The most ex
account of these old beaches is that of
C. Lawson, published in the Report
Geological Survey of Minnesota in 1
where he gives in detail the elevation
many abandoned strands as determi
careful levelling. The precision of his
minations, usually given to fraction
foot, is perhaps a little deceptive,

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[28] Geol. Sur. Minn., 20th Ann. Rep., p. 1

beaches and strand lines are quite variable things. The beach forming on the present shore of lake Superior varies as much as 15 or 20 feet in height, bays facing prevalent winds showing ridges of gravel and boulders, well rounded by wave action and free from any growth of lichen up to at least 20 feet. Nevertheless Lawson's work is of very great value.

The same strand lines with a few others observed by himself have been discussed by F. B. Taylor[29] in "Notes on the Abandoned Beaches of the North Coast of Lake Superior." He concludes that the beaches lying about 400 feet above lake Superior probably belong to lake Algonquin, and a lower series of beaches to Greater Lake Nipissing.

Measurement of Elevations.

Lawson's table of elevations shows that the beach levels are very numerous, 32 or 33 in all. Our work during the past summer covered 21 points where good raised beaches were found, and wherever possible they were measured, mainly by aneroid, but in some cases with a hand level. The results have not the accuracy of Lawson's, but as two aneroids were generally read together and checked by lake level readings before and after the heights were determined, their results should be fairly correct. Where a number of readings were made the results given represent the averages.

With us as with Lawson beaches at relatively low levels were most often met, and were found to be so numerous as to present an almost continuous series. In many cases, especially where wave ridges were measured, it was found that there was a succession of ridges each a few feet lower than the previous one, often with 50 or more feet between the highest and lowest ridge. Such a succession of ridges must indicate a fairly gradual ascent of the land.

In the following sketch of the subject the localities will be taken up from southeast to northwest, the levels of the beaches being referred to the nearest great lake, Huron to the east and southeast of the Sault Ste. Marie, Superior to the northwest of that dividing point of the waters. As lake Superior is 602 feet above the sea and lake Huron 581, there is a difference of 21 feet between the two lakes, about 18 feet of the total fall occurring at the St. Mary's rapids.

Two sets of measurements, those at the southern end of the Georgian bay, stand by themselves, being 170 miles southeast of Thessalon, where the main series of measurements begins. From Thessalon onward the gaps between the series are usually not great.

Beaches at the Southern End of Georgian Bay.

Water Levels at Owen Sound and Collingwood.

A number of old water levels were measured both at Owen Sound and Collingwood, but those at the latter point are all much higher than at the former. Three well defined terrraces were found at Owen Sound at heights of 18, 49 and 124 feet. They may be seen on both sides of the valley, and show no beach formation, being probably terraces cut by the river in a delta deposit. At 156 feet above lake Huron there is a ridge of coarse but well rounded gravel, probably a beach ridge.

The beaches near Collingwood are found at the foot or on the flanks of the Blue mountains, some miles inland. Between the bay and the foot of the escarpment there are three or four ridges, perhaps a beach formation, but possibly morainic. The presence of many scattered boulders in the fields is probably to be accounted for by lake action however, and it may be that closer scrutiny will disclose well defined beaches corresponding to those of Owen Sound. At the Kirkville mill stream one sees 20 feet of coarse stratified sand interbedded with fine silt, probably lacustrine deposit. An upper layer of the silt appears to have been crumpled by the grounding of ice floes.

The first undoubted beach is at the foot of the steep ascent of the mountain, 207 feet above the bay. There are less certain beaches at 288 and 468 feet respectively. The highest beach is 940 feet above lake Huron and is one of the best marked. A terrace large enough to contain several fields lies immediately below the sharp limestone cliff of the top of the mountain with a talus of great blocks tumbling down upon it. This cut terrace is well marked on the mountain flank three or four miles to the south. Where we visited it the mountain top rises 113 feet higher than the terrace, and no doubt formed a large island in the vast body of water which cut the terrace. Spencer in his account of "High Level Shores in the Region of the Great Lakes" marks several isolated beach levels in the mountainous region south of Collingwood, three of them about 1,400 feet above sea level and one at 1,690 feet. The beach measured by us seems about intermediate, since our readings make it 1,521 feet above the sea. Our reading at the foot of the mountain, 788 feet above sea level, corresponds fairly with one of his beach lines, where a point 773 feet above the sea is indicated, a variation not too great in the shore deposits of a great lake[30]; but fits better with Taylor's determination[31] of the Algonquin beach at Barrie, about 790 feet above sea level. The higher beaches on the Blue mountains cannot at present be identified with any ancient lake or arm of the sea that has been described, unless they correspond to stages of lake Warren. The one 468 feet above lake Huron, or 1,049 feet above the sea, may fit into Spencer's highest or Ridgeway beach.

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[29] Am. Geol. vol. xx., Aug. 1897, p. 111, etc.

The comparatively low beaches at Owen Sound probably mark phases of Taylor's Nipissing water level.

Old Beaches near St. Mary's River.

Thessalon and Mississaga Terraces.

The next set of beaches examined runs from Thessalon and the country in its rear to Goulais river north of Sault Ste. Marie. Taking them up from east to west we shall commence with those near Thessalon. Going northward to the valley of Mississaga river four distinct water levels are encountered. The alluvial plain of clay north of the town stands 26 feet above lake Huron; and another level terrace of clay forming good farming land is found west of Little Rapids at 61 feet. The higher terraces are of sand and gravel, one in the Mississaga valley forming a level sandy plain covered with farms, at 176 feet, and the highest of all 14 miles northeast of Thessalon, a terrace consisting of stratified sand and gravel rising 404 feet above lake Huron.

North of Bruce Mines terraces are very numerous. One at Rydalbank forms a widespread clay with good farm land at 132 feet above lake Huron; the next is above Ottertail lake at 148 feet. The third in height consists of stratified sand rising to 191 feet; and the fourth of sand and gravel at 295 feet. There is a well marked gravel terrace at 375 feet; and a series of wave beaches forming a gravel ridge with well rounded pebbles and boulders culminates at 430 feet. There is another well marked terrace of the same materials, perhaps only the highest stage of the last one, at 453 feet above the lake 11 miles north of Bruce mines. The lowest terrace of all occurs below the Ophir mine about 20 miles north of Bruce Mines at 98 feet above the lake. It is well defined along the valley of a creek.

Terraces along St. Mary's River.

A single well marked terrace was examined on Sugar island in United States territory not far from Garden river, and was found to rise 142 feet above St. Mary's river, just before it enters lake George. Near Garden river to the northeast of the mission there are numerous terraces, but the weather on one of our days of work was unfortunate, the barometer varying rapidly. The highest terrace observed on that day probably reaches 435 feet. On another day atmospheric conditions were better and a series of lower terraces was examined, beginning with the sandy plain 22 feet above the river, on which the settlement stands. The section shown along the lower reaches of the river consists of sandy silt with fragments of wood and bark for eight feet, coarse brown sand forming the upper part of the bank. Other sandy and gravelly terraces rise 45 and 77 feet above the river, the latter one being an old beach. A group of rather ill defined terraces runs from 149 to 158 and probably 171 feet above the river; and there is a poorly marked terrace at 213 feet above lake Huron.

Near Sault Ste. Marie.

A long series of Raised Beaches.

The Sault Ste. Marie is a most important nodal point in the great lakes, and its raised beaches have an unusual interest appreciated by several observers. Lawson has levelled a number of terraces, two within the town, the others to

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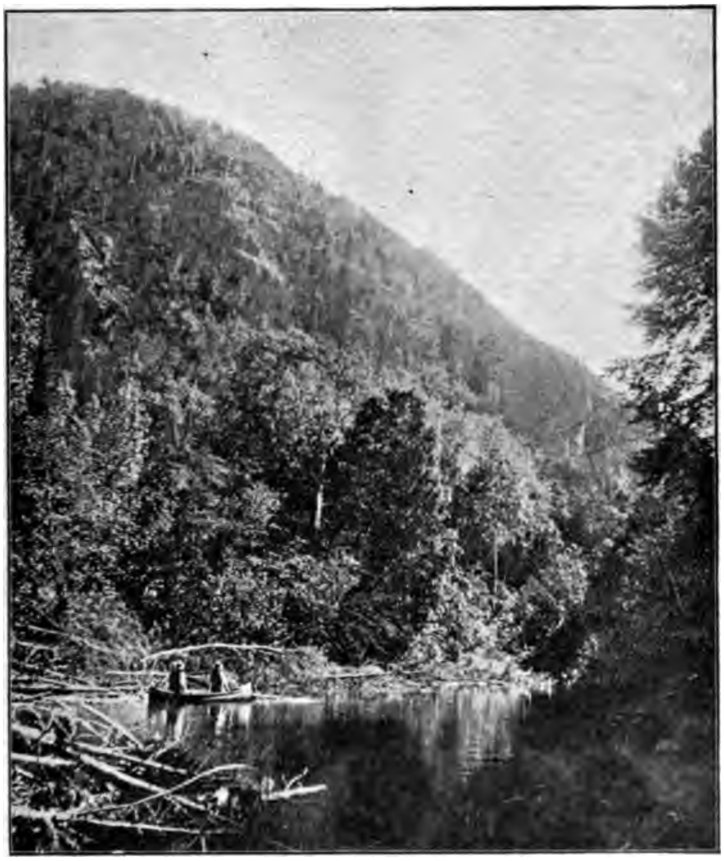
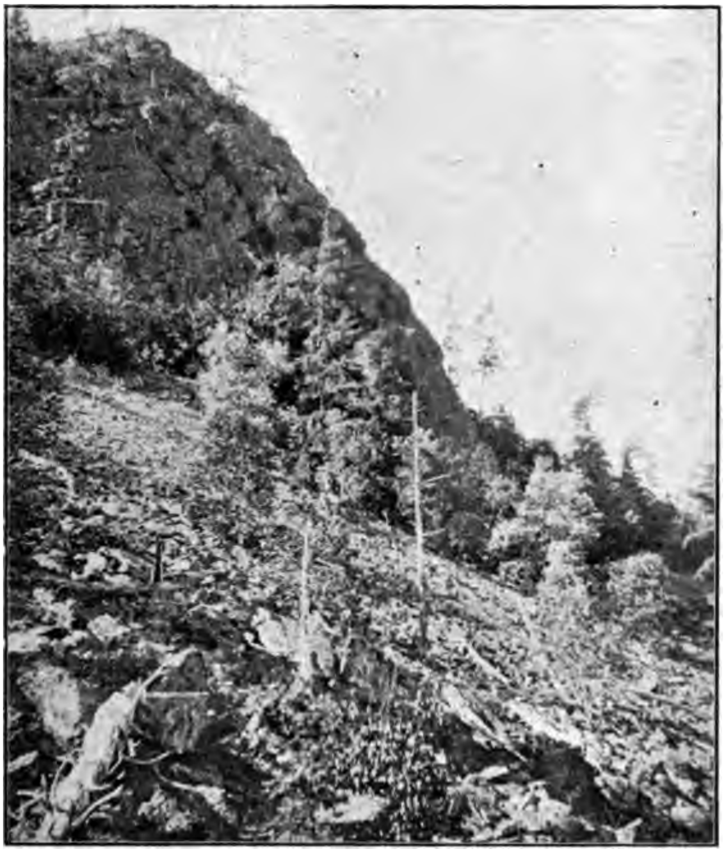
[30] Am. Jour. Sc., vol. XII., Mar., 1891, p. 202.

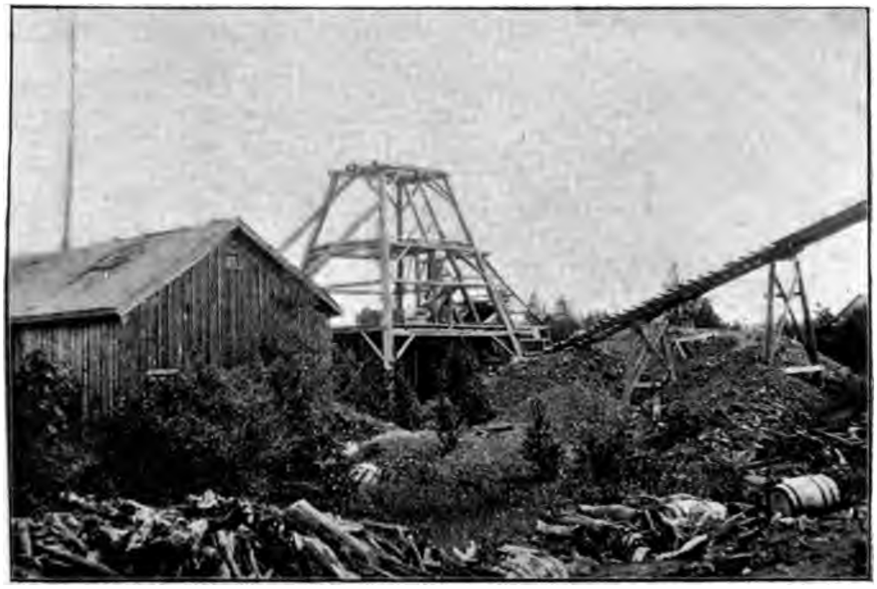
[31] Am. Geol., vol. XIV., Nov., 1894, p. 274.



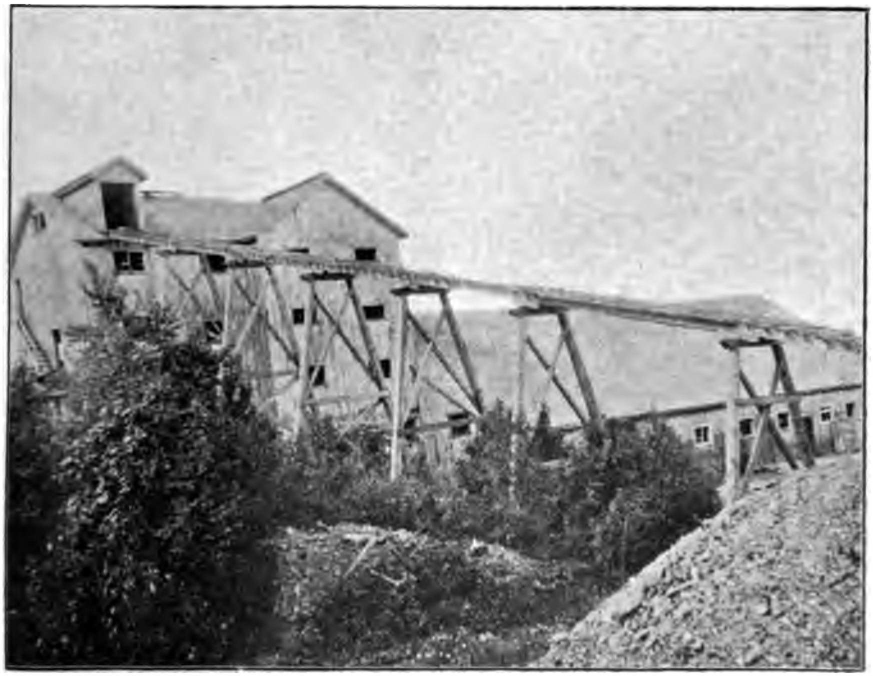
5 Cliff at north end of Echo Lake Murray's Green Chloritic Slate Willmott.



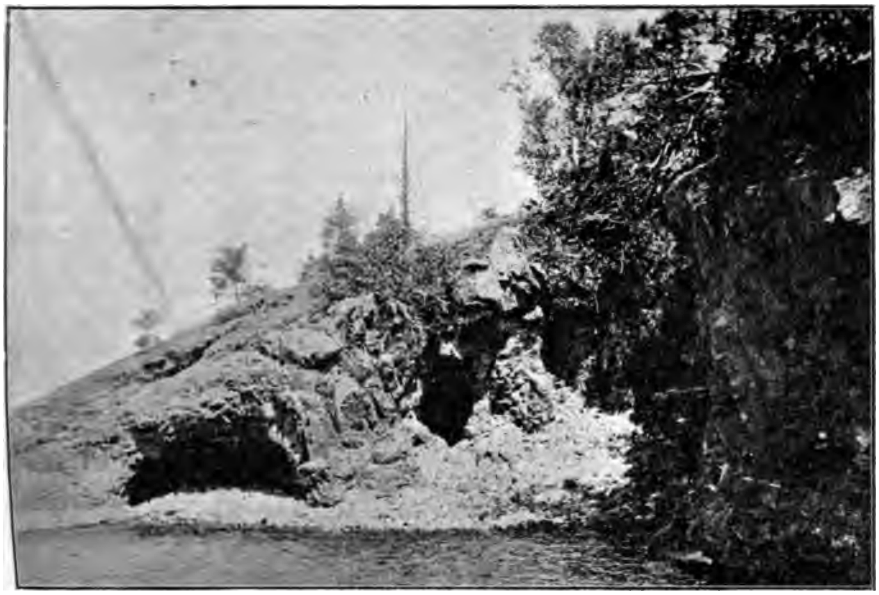
6 Cliff of Lower Slate Conglomerate on Echo Lake. -Willmott



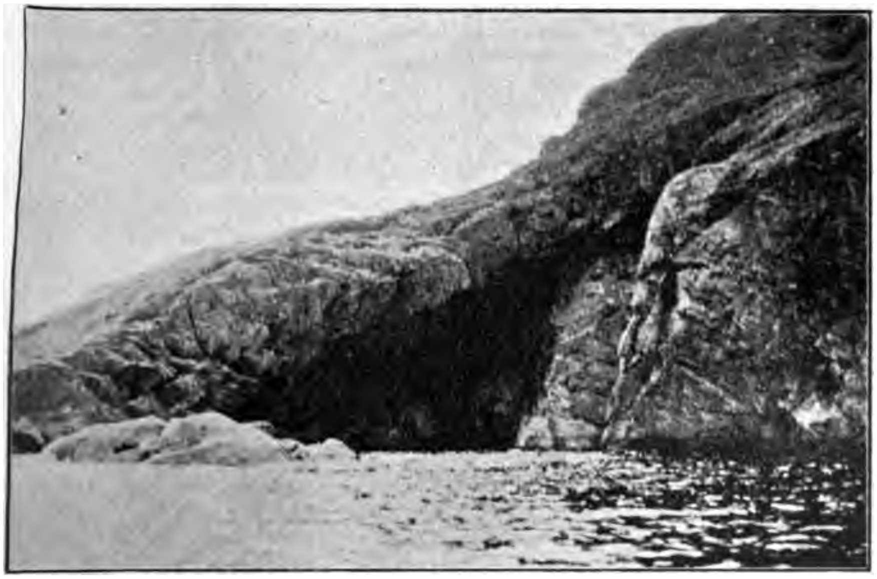
Shaft, Incline and Engine House at Mamainse. —**Willmott.**



Mamainse Copper Mill. -Willmott



Caves in Amygdaloid at Roussain's, Lake Superior. Willmott.



Cave in Conglomerate. Granite overlying, north of Pointe aux Mines, Lake Superior Willmott

it, rising at the highest point to
ve lake Superior.[32] Our excur-
ous directions north and north-
town gave opportunities for ex-
terraces within 20 miles of the
our results do not agree very
wson's. We find a number more
he does, and some at distinctly
, but only a few of our measure-
h any precision the figures given
must be remembered of course
ults of aneroid readings taken
re not to be depended on within
ss repeated a number of times
ions as to changes of barometric

e two lower terraces in town
de stretch of level clay land to
north, at about 90 feet above
e Superior or 110 feet above lake
ron, evidently an old lake de-
ntly not referred to by Lawson.
orth of this in Tarentorus town-
ured a great series of terraces,
nother at 365 and several more
and 414 feet, the latter shingle
r work northeast of the Soo,
rtail lake and the Ophir mine,
: more strands, including a series
aches from 441 to 447 feet, per-
al with Lawson's upper series,
ifference of elevation is too great
accounted for.
ion to Batchawana bay disclosed
of beaches, first in climbing the
0 feet high over which the road
in descending the same towards
r ; and finally in ascending the
nd between Goulais river and
bay. Terraces were found at 39
from 102 to 113 feet, at 136 feet,
feet, at 280 feet, at 304, between
feet, between 432 and 475 feet,
t 502 and 596 feet. The beaches
and 475 feet were partly of
el, partly sandy terraces. They
and about 30 feet higher near
bay than 15 miles south and
Sault, though too much stress
e laid on this where the determinations were by aneroid several hours away from the level of comparison. If the difference is real it indicates that this set of beaches has a quite rapid differential elevation towards the north.

Beaches on the Northeast Shore of Lake Superior.

Terraces from Gros Cap to Gargantua.

About 10 miles west of the Sault the fine promontory of Gros Cap rises where lake Superior opens out. The mountainous mass of rocks forming the cape protects two well marked sand terraces towards the east, at levels of 56 feet and 224 feet above the lake (determined by hand level). The higher one corresponds exactly to a beach measured by Lawson north of the Sault, but the lower one is a few feet higher than the main beach leveled by him in the town.

At Batchawana bay, along the river of the same name, two well marked terraces were measured at 25 and 104 feet respectively, the latter corresponding closely in height to a terrace south of Goulais river. At Mamainse 10 or 12 miles to the east Lawson indicates three beaches at levels above both of those just mentioned, his lowest being at 122 and his highest at 191 ; but we found two lower beaches with well rounded gravel at about 35 and 58 feet respectively, as well as a gravel beach with shore cliff 40 feet high at 184 feet, perhaps Lawson's highest. At Montreal river Lawson gives five beaches, the highest at 211.3, corresponding fairly with the highest measured by us (214). The lower ones on his list were not observed by us, perhaps because we kept to one side of the river only, but a stlll lower beach at 33 feet was found. At Sand river, a few miles north of Montreal river, Lawson mentions beaches at 75 and 118 feet, the latter not being well marked. Our observations probably extended farther inland, as we found well marked beaches at 72 feet, 144 feet and 234 feet, with well rounded pebbles at the lowest and highest beaches. The one at 234 feet has a distinct cut bank in the rear, and ascending this one finds a flat wooded plain, probably another terrace, 257 feet above the lake. None of these terraces except the lowest one seems to correspond to levels found at Montreal river. At Gargantua, ten miles to the northwest, a well

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. Hist. Sur. Minn., 20th Ann. Rep.

defined beach of rounded boulders was found at 72 feet; but no higher ones, although a neighboring hill rising 431 feet above lake Superior was ascended.

Terraces at Michipicoton.

Between Michipicoton Post and Wawa lake, at the foot of the deep Michipicoton bay, a fine series of beaches is crossed by the portage road connecting the two points. We measured eight fairly distinct ones and noted numerous minor beach lines between. The same series was measured last year by Prof. Willmott with accordant results for the lower terraces, but some differences for the higher ones[33] We found terraces on sand plains at 38, 75, 83 and 99 feet within a mile of the landing on Michipicoton river, the two upper ones being practically the same as Prof. Willmott's (84 and 100 feet). A fifth level at 136 may represent his third at 145; and a sixth at 240 his fourth plain at 224. Wawa lake stands at the level of a wide sandy plain 352 feet above lake Superior (328 Willmott), but is dammed by a terrace rising 20 feet above it. Another terrace rises to the north of Wawa lake to a height of 70 feet above its surface, according to Prof. Willmott, or 420 feet above lake Superior. Prof. Willmott finds a still higher beach (441 feet) near Whitefish lake to the north.

Terraces at Dog River.

A magnificent set of terraces may be seen from the lake along the mountainous shore near Dog river about 15 miles west of Michipicoton Post. These were measured by Lawson, who gives seven elevations ranging from 16.5 to 323.4 feet above the lake. Our measurements were made at a point where the lower terraces have been cut away by the present lake, so that the lowest reading of a distinct terrace is 119 feet, though several indistinct stages may be seen a few feet below, probably representing Lawson's level at 100.7. Another set of readings gives 252 feet (Lawson's 255.4) with several less distinct beach ridges below. Our highest level is 360 feet, with numerous ill-defined ridges beneath. It is probable that Lawson's measurements were made somewhat farther east, where the lower series appears to be more complete.

Measurements on Pucaswa and Swallow Rivers.

Lawson measured no beaches between Dog river and Jackfish, a distance of over 80 miles in a straight line towards the northwest, and we saw no high level terraces except at Pucaswa river. Along this river three terraces were measured at 99, 150 and 271 feet respectively, but with only one aneroid and a single reading each. More doubtful ones were found at about 430, 610 and 645 feet, near its headwaters. Beautiful examples of low level beaches consisting of well rounded but lichen-covered stones occur two or three miles west of Pucaswa, rising 16 and 42 feet above the water, but evidently forming a continuous series with the present beach, whose highest level of rounded boulders still uncovered with lichen stands six feet above the lake. At Swallow river ten miles northwest quite similar beaches rise 45, 54 and 63 feet above the water, with round lichen-covered stones. They are apparently quite recent, since no bushes nor other vegetation except lichens have obtained a foothold. They represent perhaps Taylor's Nipissing beach, or possibly his Sault beach.[34]

It is rather singular that no distinct high level terraces are to be seen on this part of the shore, since the valleys between the mountains seem as suitable to receive them as those to the east or those to the northwest. Excursions to high inland points near Swallow river and Spruce harbor disclosed nothing of the kind.

Beaches on Michipocoton Island.

A very interesting group of beaches is to be found in the western end of Michipocoton island, both on the north and on the south sides, easily examined on the road leading over the hills from the Quebec mine to Quebec harbor. There are several fairly distinct sets of gravel beaches, each having a number of ridges below the highest one. The lowest one is fro 15 to 22 feet above the water and is marke by a fine sea cave whose floor is at the lowe level. Next come indistinct beach lines running up to 65 feet above the lake, wher a terrace affords space for several house Above this there are faint stages culminati at 78 feet, and then apparently a gap unt

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[33] Eur. Mines, Ont., 1897, p. 193.

Am. Geol. vol. xx., Aug. 1897, p. 127.

128 feet, when fairly distinct wave lines begin and run up to 178 feet. At 204 feet there is a well marked gravel beach, perhaps just the highest stage of the last series; and at this level on the south side of the divide a lake is found, probably dammed by a beach deposit. Above this there is a wide terrace occupied by a farm, its highest point being 233 feet. There is a lake at this level also. The highest terrace observed reaches 295 feet. The terrace lying somewhat above the 400-foot level, found at so many points to the east and southeast, was not observed, but may yet be found among the higher hills of the island, which were not explored. A comparison of the series of beaches just given and those of Dog river 35 miles to the northeast, as measured by Lawson, shows comparatively few points of agreement, the only exact one being the level of the lowest beach in each, 15 and 16½ feet respectively. Whether there has been differential elevation, placing the beaches at Dog river higher than the corresponding beaches at Michipocoton island is hard to determine, particularly when one recalls that almost all of these beaches are composite and have a range of a number of feet.

Results of Observations.

The results of our observations summed up in the accompanying table giving 20 sets of beach levels near St. Mary's river and along the coast of lake Superior for 120 miles towards the northwest show a great number of slightly different levels. One may pass from the present lake shore up to beaches 475 feet above it with a succession of steps at one point or another, never exceeding 10 feet at a time; while the difference in level between the top of a storm beach at the present day and the subaqueous terrace of a delta now

Level of Raised Beaches (on L. Huron and L. Superior) above L. Superior.

Above L. Superior 0.	Swallow R.	Kilkenny.	Pucaswa R.	Michipocoton Island.	Dog R.	Michipocoton Post.	Gargantua.	Sand R.	Agiwa R.	Montreal R.	Mamainse R.	Batchawana R.	N. of Goulais R.	S. of Goulais R.	N. W. of Soo.	Gros Cap.	N. of Soo.	Garden R.	Sugar Island.	Bruce Mines.	Thessalon.	Collingwood.	Owen Sound.
50.... 100....	45 54 63	6 16 42	99	15 to22 65 to78		38 75 83 99	72	72		33	35 58	25 35		57	39	56	14 44 89	23 56		77	5 40		—3 28
150.... 200....			150	128 to 178	119	136		144	111 126		184	104		102 113 187	136 191		185	128 137 150 192	121	111 127 170	155	186	103 135
250.... 300....			271	204 233 295	252	240		234 257		214			285		277	224	229 244			274		267	
350.... 400....					360	352 372							333	362	304		327 379			354	383		
450.... 500....			*430			*420							463 475	432	442		441 447	*435		409 432		447	
			610? 645?												502 596							919	

* About.

forming on lake Superior would certainly be more than 10 feet, and probably not less than 15. It must of course be remembered that heights determined by aneroid, particularly when the readings are two or three hours distant in time from the level with which they are compared, are not certain within the limits of a few feet.

Turning to Lawson's 48 feet precisely leveled beaches as given in his table of the terraces and beaches on the north side of lake Superior, the same peculiarity is evident.[35] The levels ascend to 260 feet without a gap greater than 14 feet, and in most cases by stages of less than ten feet. Lawson himself assumes that there may be a difference of level of 15 feet in different parts of the same beach, but then proceeds to group the abandoned strands in 33 sets, the levels of each set varying among themselves less than 13 feet. However in a number of these groups of levels the highest of one group approaches very closely to the lowest of the next above, and it seems doubtful if most of his horizontal strand lines are to be looked on as produced by sharply distinct stages of the water. It seems more probable that the change was on the whole a very gradual one, with few well marked halts in the fall of the water.

With regard to differential elevation toward the northeast the evidence is indeterminate. There is no well defined shore like the Iroquois beach around lake Ontario on which one may drive for a hundred miles, and so determine with precision the differences of elevation; and the usual occurrence of several wave-built ridges each three or four feet higher than the last one makes the comparison of one set with the next ten miles off very difficult.

An attempt has been made to distinguish the beaches representing Taylor's Algonquin, Nipissing and Sault water levels, but with little success on the whole. Probably the beaches running from 432 to 475 feet in the neighborhood of the Soo correspond to the Algonquin beach, though they seem somewhat too high, but the correlation of the others would be largely guesswork.

Glacial Geology.

Erosion of the Till on the Shore Lines.

Owing to the immense amount of wave erosion along all the shores examined, often up to a height of 450 feet or more, the sheet of till which originally covered much of the region has largely been removed to be redeposited as stratified clay in the lower terraces; or else has been buried out of sight by lacustrine deposits. Typical boulder clay is generally to be seen however in valleys or sheltered spots above the beach lines; as, for instance, on the ridge 800 feet high crossed by the road from the Sault to Goulais river, and the similar ridge forming the water shed between Goulais river and Batchawana bay. At these points one sees stony till, sometimes with rough morainic shapes. Near Day's Mills, on the main road towards Thessalon, which lies some miles to the west, a very stony morainic ridge occurs, and has in part been worked over by wave action, all the finer materials being removed at the level of an old beach.

Pebbles of the Glacial Drift.

Rock Materials.

The materials left by the ice include an immense variety of rock species, largely from neighboring localities; such as the splendid boulders of jasper conglomerate at Bruce Mines, evidently derived from the Huronian just to the north. The only rock undoubtedly brought from a distance is limestone, often accompanied by chert. Pebbles and small boulders of this rock were found at a number of points among the beach gravels, but nowhere south or east of Doré river. As many of these pebbles are fossiliferous a collection of the best specimens was made in order to determine the age of the rock, and if possible its source.

Determination of Fossils.

The fossils were given to Mr. B. E. Walker of Toronto for determination, and his kindness in working over the material, most of which was fragmentary and badly preserved, is much appreciated.

Mr. Walker finds Atrypa reticularis, Favosites Emmonsi, Rominger, fragments of cyathophylloid corals, of stromato-poroids, a small pebble of a syringostroma, and a fragment of clathrodictyon, apparently C. laxum, Nicholson: forms belonging mainly or wholly

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[35] Geol. Nat. Hist. Sur. Minn., 20th Ann. Rep. for 1891, p. 289.

Devonian. The favosites is Upper
erg or Corniferous, while atrypa may
r Upper Silurian or Devonian,
limestone and chert pebbles were
i also in the railway gravel pit east of
la, and another pit west of Bremner.
latter case there were many white
.e pebbles.
ource of these Devonian pebbles is
r the area of Devonian limestone
near James bay, the nearest point
of which as mapped by Dr. Bell is
only 150 miles away in a direction
20° E, five degrees more to the east-
ın the average direction of the striæ.
found similar pebbles in the drift to
th and east [36], and Logan found
n pebbles near Pic island.[37]

Glacial Striæ.

lly polished and striated surfaces are
s, and many directions of striæ were
noted by Murray on his map of the
original Huronian region ; the aver-
age of 38 readings being s. 15° w.,
is of them lying between s. 12° w.
5° w. He notes one set of striæ
south and two running east of south
and s. 30° E.), both in the Goulais
on. In our own work few observa-
striæ were noted, as Murray had
the ground so well, and only two
mentioned. Near the summit of
mountain, seven miles east of Spruce
striæ were found about 1,500 feet
e Superior with a direction of s. 50°
a point of quartzite on the east side
lake was found to be splendidly
and striated in more than one direc-
ome cases with chatter cracks. The
d strongest striæ run s. 70° w. ;
set though somewhat variable are
stinct and run s. 40° w. ; while a
rs point s. 55° w. The directions
Murray are s. 55° E. and s. 70° E.
uth side of Echo lake. The latter
vater is enclosed by precipitous hills
serving the name of mountains, and
direction of striæ corresponds to the
of the shore, having been made perhaps during the retreat after the last advance of the ice. when the mass was no longer thick enough to over-ride local obstructions and so conformed in its movements to the direction of the deeper valleys.

At Rydalbank also, a few miles north of Bruce Mines, two sets of striæ were observed, an older one s. 20° w., and a later one presenting only a few striæ crossing the others with the direction s. 45° w.

The Original Huronian Area.

As rocks generally called Huronian furnish most of the ore deposits of Ontario, the question of the character of the Huronian rocks and their relationship to the Laurentian is one of much importance, not only to the man of science, but also to all who are interested in the development of our mineral resources.

Logan's Huronian Region.

The Huronian area first described and carefully mapped by Sir William Logan and his assistant Murray extends along the northeast shore of lake Huron from Blind river almost to Sault Ste. Marie, another smaller area being shown between Goulais and Batchawana bays on the southeast corner of lake Superior. Laurentian rocks are represented as separating the two, but the interior of the country is left a blank. Later explorations by Bell and others connect these two areas and extend them as a broad band to the Sudbury region on the northeast.

The region was first examined by Logan and his assistant in 1848, a short report on the North Shore of Lake Huron being published the following year giving a preliminary sketch of the geology. Logan's attention was turned to the region on account of the copper mines then being opened up near Bruce Mines.[38]

The work begun by Logan was carried on by Murray in 1857 and 1858, the results with uncolored maps and sections being published in the reports of the Survey for those years. In the large report of 1863 Logan's views as to the Huronian are summed up and the results of his and Murray's work published with an excellant map which, though on too small a scale, was the most detailed map of any Canadian Huronian region up to

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Sur. Can., 1870-71, p. 349. [37] Ibid.
. 353.

[38] Geol. Sur. Can., 1849.

the time of Dr. Lawson's work on the Lake of the Woods. Since Logan and Murray's time Irving[39] and Van Hise[40] have visited some of the typical localities and described critical points in order to correlate the corresponding series of rocks to the south and west of lake Superior. The Winchells also have visited the region and published descriptions of portions of it.[41]

Other Huronian Areas.

While Logan and Murray's chief work was done in the region near St. Mary's river, they also examined areas which Logan describes as of the same age in various other parts of Canada, particularly near Doré river west of Michipicoton, and lake Temiscaming on the boundary between Ontario and Quebec. In fact in the account of the Huronian in the Geology of Canada, 1863, Logan begins with the Temiscaming rocks, goes on to the Doré section and ends with the original Huronian region. That he considered the three as of equivalent age is evident.

Rocks of the Thessalon Trough.

Measurement of the Series.

Logan's study of the Huronian, or Lower Copper-bearing series, began at Bruce Mines, but Murray followed up the work in various other parts of the region, especially along the lakes and rivers, tracing out in particular the easily recognized bands of limestone. He finds a rather complex series of faults intersecting the series, which are also thrown into two rather gentle folds with a dip ranging from 0° to 45° in a section worked out in the Thessalon trough. The series of rocks near Thessalon is given by Logan in ascending scale as follows :

1.	Gray quartzite	500 feet.
2.	Greenish slates	2,000 "
3.	White quartzite	1,000 "
4.	Slate conglomerate	1,280 "
5.	Limestone	300 "
6.	Slate conglomerate	3,000 "
7.	Red quartzite	2,300 "
8.	Red jasper conglomerate	2,150 "
9.	White quartzite	2,970 "
10.	Yellowish chert and limestone	400 "
11.	White quartzite	1,500 "
12.	Yellowish chert and impure limestone	200 "
13.	White quartzite	400 "
		18,000

In addition there are overflows of greenstone, dikes of the same rock and eruptive bosses and dikes of granite.

Huronian and Keewatin compared.

The series of rocks here presented is so widely different from the rocks usually classed with the Huronian in western Ontario that one readily understands why Lawson gave the western series a distinct name, the Keewatin, and doubted whether the two series are of the same age. It is proposed to describe briefly the various rocks of the series as examined by us last summer, comparing them with the so-called Huronian rocks of the Rainy lake region and drawing some inferences as to the conditions of the time and the relations of the Huronian to the Keewatin and Laurentian.

It will be convenient to take up the series in the reverse order, starting with the latest, and ending with the earliest.

White Quartzite, Chert and Limestone.

Logan's No. 13 and 12, white quartzite and yellowish chert and limestone, we did not see ; but similar rocks, probably No. 11 and 10, occur on the south side of Ottertail lake where the exposures are not very good. Besides the white quartzite there is a band of brownish rock looking like felsite, probably arkose, since under the microscope one finds all the customary minerals of granite. The thin section might easily be taken for a microgranite but for the rounded particles of quartz with a faint dusty margin suggesting a clastic origin. Impure limestone with brown chert occurs near the southeast corner of the lake.

No. 9, white quartzite, shows much better than the limestone just to the north of Ottertail lake, as might be expected from its more durable character. Good examples may be found near the south end of Great Lake George also. They are clearly granular though well cemented, and look quite different from any western quartzites or the friable sandstone of the Couchiching near Fort Frances. They are usually quite free from darker ingredients, and almost as white as marble.

Jasper Conglomerate.

The famous jasper conglomerate (No. 8) attracts the eye instantly with its blood red jasper pebbles and black pebbles of chert in a white ground mass of quartzite. Looking more closely, pebbles of white quartz are seen also. The jaspers have not the oölitic look often found in the jaspers of the iron bearing rocks west of lake Superior. They are very unequally distributed, and but for their brilliant color would be neglected in naming the rock, since the portions sprinkled with them form really very subordinate parts of the rock and merge on all sides into ordinary quartzites, or quartzite conglomerates with white pebbles only. These rocks are fairly well displayed a few miles north of Rydalbank on the road between Ottertail and Rock lakes. The best example seen by us is one not shown on Logan's map, on the northern shore of Trout lake, a small body of water two or three miles north of Echo lake; and they are found also a mile or two farther north on the pond called Iron lake. On Trout lake the band is 300 or 400 yards wide, strikes about 140° and dips about 35° to the northeast. It is probably part of a band lying roughly parallel to the one shown by Logan as running from Great Lake George past Rock lake to a point not far from Thessalon; and may represent the same bed of rock on the north side of an anticline.

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[39] U.S. Geol. Sur., 7th Ann. Rep., "Classificationof the Early Cambrian and Pre-Cambrian Formations," R. D. Irving.

[40] Ibid., 16th Ann. Rep. "Principles of North American Pre-Cambrian Geology," C. R. Van Hise.

[41] 16th Ann. Rep. Geol. and Nat. Hist. Sur. Minn., 1887.

Red Quartzite.

The red quartzite (No. 7) is really arkose, consisting of rounded grains of quartz, weathered grains of various felspars, dusty interstitial particles and sometimes iron oxides. Good examples occur just west of Rock lake and also three or four miles west of Campement d'Ours. This rock, where studied by us near Rock lake, passes by gradations into jasper conglomerate and sometimes contains jasper pebbles, which are however not very conspicuous in their setting of brownish red sandstone.

Upper Slate Conglomerate.

After passing Rock lake on the road north from Bruce Mines to the Ophir mine, Logan's upper slate conglomerate (No. 6) appears, rising as a steep hill. Parts of it contain few or no pebbles but other parts are more or less crowded with large well rounded boulders, mostly of red granite, less often of gneiss. The same rock may be studied on the southern shores of Echo lake, where greenish quartzite is seen first, and afterwards what may be called graywacke conglomerate, in general a fine grained gray rock with light and dark colors curiously mingled, in which large and small pebbles of red granite are common. Dark gray green pebbles coarser in grain than the matrix also occur, and a mass of quartzite with irregular outlines was seen partly enclosing a granite boulder. Paler greenish parts of the matrix seemed to be enclosed with bands of darker green, showing a grain like that of wood about a knot. One small pebble of red jasper and a pebble of buff limestone were found. It is probable that this graywacke conglomerate obtained part of its materials from the massively developed conglomerate of a similar kind not far to the north. The pebble of limestone probably indicates an interval of erosion after the consolidation of the next member of the series. Pebbles of limestone are more commonly found in the same band of graywacke-conglomerate north of Garden river, as reported by Van Hise.[42]

The Limestone Band.

One of the most interesting rocks in the whole series is No. 6, which consists of limestone. On Echo lake it forms two promontories on opposite sides of the lake, as if it withstood weathering better than the other rocks of the shore. Approaching it on the western shore one sees first greenish slate containing a few granite boulders intricately interfolded with brownish gray limestone, as if they had been interstratified. Turning the point there is a shore of wonderfully contorted limestone, "exhibiting on a small scale a beautiful representation of almost all the accidents that occur in stratification," to quote Sir Wm. Logan.

On weathered surfaces shaly bands stand out as darker colored ribs. In the middle of the band there is a conglomerate of small flat, but rounded, limestone pebbles in a limestone matrix, well seen on the weathered rock, but almost invisible on fresh surfaces. Some of the pebbles suggest shells, though clearly not of organic origin. In thin sections the rock proves to be a fine grained, fairly pure calcite with a few dusty looking strips of darker color, where black particles and tiny grains of quartz show themselves.

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[42] Pre-Cambrian Geol., p. 777.

Several narrow dikes of diabase and one of amygdaloid cross the limestone.

The limestone band shows the contortions seen when a softer rock is squeezed and folded between bands of harder rock, so that the dip is not easily determined. The prevalent dip seems to be about 20° towards the south.

The quarry at Garden river presents a fine exposure of the same limestone, but there the dip is 70° or 80° towards the south. A similar band of limestone, classed on Logan's map with the ones just described, occurs near the Wellington mine, and is crossed by the railway at mile 142, a mile east of the Bruce Mines station. Here it contains flat black pebbles of slate, and has apparently a vertical dip.

In general these limestones are not very crystalline, and might be paralleled by many limestones of far later age. The limestones of Steep Rock lake above Rainy lake are very like them, both on the large scale and under the microscope.

Another band of rather less pure limestone occurs on the east shore of Echo lake, some distance to the northeast of the band shown on the map. The impurities are mixed more thoroughly through the rock and do not stand out as prominent ribs on weathered surfaces.

Lower Slate Conglomerates.

The lower slate conglomerate (No. 4) is seen to fine advantage north of the main limestone band on Echo lake, where it rises 500 feet as a steep cliff, with a talus of large blocks beneath. It is a graywacke conglomerate with some quartzite. The pebbles and boulders are very unequally distributed and consist of granite, felsite, quartzite and greenstone, no limestone or jasper being found. On the map the same conglomerate is shown along the shore at Bruce Mines. About three miles west of that village several finely glaciated "whaleback" islets display splendid sections of this rock with well rounded boulders, mainly of red granite in a dark green ground mass. Some of the boulders are three feet in diameter. Graywacke conglomerates of the type described under No. 4 are common farther northeast in the same great Huronian band, and may be seen in the Wahnapitae gold region near Sudbury. Parts of them are very like parts of the Shoal lake conglomerate of the Rainy lake Keewatin, though in general the Shoal lake rock is much more schistose.

White Quartzite No. 3.

Subdivision No. 3, white quartzite, is mapped as occurring along the shore between Bruce Mines and the peninsula west of Thessalon, and then as stretching some miles to the northeast till cut off by a fault. The point of the shore east of Bruce Mines consists of red quartzite or arkose, but the rest of the shore was not examined by us. Where the band is crossed by the railway as it approaches Thessalon from the west gray quartzite is found (¼ mile east of mile 140) with some black chert pebbles as well as pebbles of white quartz and a few of jasper. At this point the beds seem to be horizontal, though the limestone band two miles to the west appeared to be vertical. East of mile 140 as far as mile 135 red quartzite is the main rock seen, often cut by large dikes of diabase. It contains red felspar and a few chert pebbles, and the bedding seems to be generally horizontal, though variations of dip from 0° to 45° occur. This subdivision is wanting north of Echo lake, the green slate coming in immediately after the lower slate conglomerate.

Green Chlorite Slate.

No. 2, green chlorite slate, is mapped as a band running northeast of Thessalon to a line of fault, and also at the north end of Echo lake. At the latter point it rises as a splendid cliff, with what appears to be nearly horizontal bedding. The rock is a very cleavable gray green slate or phyllite, consisting of chlorite with some calcite (or dolomite) and angular particles of quartz with a few grains of magnetite. None of the rutile needles characteristic of most slates can be seen in a thin section. There are Keewatin slaty rocks of an exactly similar kind in the Lake of the Woods region.

The rocks mapped as of the same age near Thessalon are apparently all more or less altered basic eruptives or ash rocks. A dark green sausuritic rock with lighter parts of material richer in epidote presents various phases of crush conglomerates and agglomerates. In other parts little structure is to be seen, and in still others, e.g., at a point in Thessalon harbor, there are very distinct

›f amygdaloid, generally thin and sep- by beds of weathered diabase without ıygdaloidal structure. The amygdules darker green than the rest of the rock, ·e filled with serpentine. These amyg- s must have been successive flows of No rocks of the sort have been de- d from the western Keewatin.

last subdivision (No. 1) recognised by is mapped as forming a narrow band just beneath the green slate and between it and the Laurentian, starting at the shore three or four east of Thessalon and running in a ·asterly direction till cut off by the 'ault to the north. He describes it as quartzite, thin bedded in some parts ; ickness very doubtful" ; and puts the ess at 500 feet. We coasted somewhat lly along that part of the shore and :ossed the strike of the band on the y to the north, but saw no rock corres- ıg to the description. However a thick- f only 500 feet might be covered with drift and pass unnoticed. What we did observe was a basal conglomerate, overlooked by Logan, but well described by Irving[43] and Van [4] As this is a crucial point in reference relation of the Huronian to the Lau- ı, we studied it with considerable care. d of small islands along this part of ore gives excellent exposures, making more surprising that Logan and Murray, y so keen-eyed, should have overlooked

rock may be described as a graywacke merate, in which the cement is dark nd rather coarse, containing grains of and felspar ; while the pebbles and ·rs are very unequally distributed, as ıt graywacke conglomerates. The peb- ıd boulders are mainly of granite and evidently derived from the underlying ıtian. In addition there are felsites rtz porphyries and a few darker pebbles ;ing to the hornblendic masses enclosed Laurentian. Very rarely one finds a pebble of red jasper. The last point has some importance, as showing that this conglomerate is not the lowest of all sedimentary rocks. The inference drawn by Van Hise from the jaspers in the red jasper conglomerate of the Upper Huronian, that these are derived from the red jaspers associated with certain parts of the Lower Huronian[45] will apply here also. If jasper is necessarily Huronian the basal conglomerate near Thessalon represents the base of the Huronian at that point only ; and in other regions Huronian rocks of an earlier age are to be found.

In order to study the contact at a fresh point we walked east from Thessalon along the railway and found it rising as rounded hills in a swamp south of the track about half way between mile posts 127 and 128. The graywacke conglomerate here presents the same character as on the shore, and is crowded with large and small boulders of gneiss and granite like the Laurentian rocks to be seen beneath it.

A hill lying about half a mile north of the road between Sault Ste. Marie and Garden river presents perhaps the same contact ; but the evidence does not seem to me clear, since the conglomerate or rather breccia consists wholly of granitic material and is possibly a crush conglomerate formed by faulting instead of a water-formed rock.

The contact of Laurentian and Huronian was looked for north of Garden river in territory unmapped by Logan; but owing to the widespread lake deposits it was not to be seen. The first rock met after passing the "slate conglomerate" hill lying north of the Garden river limestone band is reddish gneiss or granite and a gray gneissoid rock penetrated by granite dikes, the whole no doubt Laurentian.

Eruptive Rocks in the Huronian.

The eruptive rocks associated with the Huronian are considered by Logan to be partly contemporaneous flows, and so to be reckoned in with the general series, and partly later eruptives penetrating the Huronian. The large mass of greenstone in which the copper veins are found at Bruce Mines, Logan thinks to be an interstratified bed, and he speculates as to its

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S. Geol. Sur., 7th Ann. Rep., p. 429, etc., veral full page illustrations.

e-Cambrian Geology, p. 777.

[45] Pre-Cambrian Geology, p. 778.

ss and the depth to which the veins followed in it as country rock.[46] observations do not bear out this y. On a point less than a mile east of the and on an island just beyond, we found uptive contact of exactly similar diabase red quartzite, many dikes of diabase aching off from the main mass into the rtzite, at times crossing it in parallel eets with much regularity as if interstrati d, at others cutting it irregularly. The ruce Mines diabase, which is quarried and hipped to Cleveland as road metal, contains little quartz as a micropegmatitic intergrowth with the plagioclase; and the same was found to be true of the striking hill rising a mile inland from the head of Great Lake George; so that quartz diabase seems to be the prevalent type. It is not certain that any of the diabase masses seen by us are surface flows, all the evidence observed being to the contrary. That there were contemporary lava flows and volcanic activity is however proved by the successive amygdaloid beds at Thessalon with their accompanying beds of ash rock and agglomerate.

Eruptive masses of granite penetrate the Huronian, as observed by different geologists who have visited the region, but none of them were particularly studied by us. In appearance there seems little or no difference between them and the eruptive granites of the Laurentian, though the large number of granite boulders in the graywacke conglomerates proves that granite was a very important constituent of the Laurentian before the Huronian was deposited.

Components of the Rocks.

Source of the materials of Huronian Rocks.

An interesting set of problems is presented in regard to the source of the materials of the typical Huronian rocks. Except at the small section east of Thessalon, where the basal conglomerate overlies the Laurentian and is made up of the rocks at hand, it is not at all easy to suggest an origin for them. If we sum up the various rocks of Logan's section, placing gray and white quartzite and jasper conglomerate together as having essentially the same composition, we have five main series, of which rocks formed mostly of quartz make up 8,520 feet; graywacke conglomerate, containing a good deal of quartz with some basic material as well as many granite boulders, forms 4,280 feet; red quartzite, largely arkose or crushed granite or gneiss, reaches 2,300 feet in thickness; slate, really phyllite or a chloritic slate, 2,000 feet; and limestone with chert 900 feet. When it is remembered that the Laurentian so far as known in the region contains no quartzite and few quartz veins, the origin of the many cubic miles of nearly pure quartz in the 8,520 feet of quartzite is not easy to find. If derived from granite and gneiss, at least four times the bulk of these rocks must have been ground up and the clayey and other materials removed.. The 2,300 feet of red quartzite or arkose and the 4,280 feet of graywacke conglomerate with the more or less numerous boulders may be conceived to have come rather directly from the Laurentian. The 2,000 feet of chlorite slate or schist may represent the more basic and finer grained materials of the granites ground up to form the quartzite. The materials for the 900 feet of limestone could only be supplied by some of the basic silicates, such as anorthite or labradorite; for crystalline limestone has never been reported from the Laurentian of the region.

Suggestiveness of the Jasper and Chert Pebbles.

The most puzzling components of these rocks are however the pebbles of jasper and chert. While they occur especially in the 2,150 feet of jasper conglomerate, they are found to greater or less degree right at the base of the series. We found numerou chert pebbles and some of jasper in Logan' white quartzite, No. 3, and a few red jaspe turned up in the basal conglomerate east Thessalon, the lowest of all. Now jasp and chert or Lydian stone are unknown the Laurentian. They are well known members of the Animikie, classed by som American geologists as Lower Huronia Both the jasper and the chert are found el where as stratified sedimentary beds of Huronian, but not in the Keewatin. jasper pebbles though not of great imp ance as to bulk are present often in l

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[46] Geol. Sur. Can., Report on North Shore Lake Huron, 1849, p. 45.

ırs and are very widely spread. Logan
them as a continuous band 26 miles
ınd adds another small area beyond,
a total length of distribution of nearly
es, and they are found more or less
a width of 15 miles.

most probable source of these pebbles
ɜ area of jasper like that west of lake
or, but now completely removed, or
sight beneath one of the great lakes.
ver the source of the jasper, these peb-
ove the presence of a non-Laurentian
u considerable quantities before the
; bed of the typical Huronian was laid
The typical Huronian is therefore
ı earliest sedimentary rock, nor is it
ɛt rock in succession after the Lauren-

The Laurentian of the Region.

Laurentian of the region was studied
ɔus points with some care, particularly
east of Thessalon where it rises
from under the Huronian basal
conglomerate. On the islands four
miles east of Thessalon the Laur-
consists of red granite and granitoid
of the usual type. In both rocks
re large angular fragments of a dark
ɔrnblendic rock just like the horn-
schist often found on Rainy lake,
there is an eruptive contact of the
ian gneiss with a basic Keewatin
In that region on finding such in-
one would expect to find the solid
hist shortly after. A thin section of
ıen of the schist inclusions shows the
be a quartz-hornblende schist with a
thoclase very similar to some Kee-
hists near the Laurentian contact.
; the "Soo" line railway at mile 127,
; of the basal conglomerate, typical,
ated Laurentian gneiss is found,
ɔre containing many angular inclu-
green schist; and from mile 123 to
wide bands of fine-grained gray
ery like Keewatin or Couchiching
cur in the gneiss, the latter making
ive contact. At some points granite
hrough both. If these rocks were
ı the Lake of the Woods or Rainy
re would be no hesitation in assign-
ı to the Keewatin.

North of Garden river, near the Victoria mine, Laurentian gneiss penetrated by granite dikes and enclosing masses of green schist occurs, but part of the green schistose rock appears to be a sheared dike of greenstone, and so may be later than Laurentian.

The Laurentian to the west of the typical Huronian region may be seen on the road across the mountains from Sault Ste. Marie to the Goulais River settlement, where a gray gneiss, often greatly contorted, contains strips or larger fragments of green schist resembling the Keewatin.

Huronian Areas on Lake Superior.

Besides the original and typical region of Huronian rocks north of lake Huron, there are a number of areas along the eastern and northern shores of lake Superior which have usually been classed and described as members of the same series. These latter have been studied by us with the object of comparing them with Logan's original Huronian on lake Huron and Lawson's Keewatin on Rainy lake.

The Goulais—Batchawana Contacts.

Between Goulais Bay and Batchawana Bay.

Logan maps an area of Huronian between Goulais and Batchawana bays near the southeastern end of lake Superior, coloring it chiefly as upper slate conglomerate, though a small patch of jasper conglomerate is shown on Goulais bay. We spent three or four days in the region, mainly examining the contact of the Laurentian and Huronian. Passing north from Goulais river by a road leading over a pass to Batchawana bay one finds quite a variety of Huronian rocks. At a school house south of McAuley's post office a steep hill consists of beds of felsite alternating with very cleavable slate, both having only a gentle dip. At McAuley's itself the rock is characteristic slate conglomerate. Two or three miles southeast of McAuley's the highest point in the region is found to consist of white quartzite, which apparently overlies slate showing a well defined cleavage nearly at right angles to the equally well-marked bedding.[47] The quartzite rises to a height of more than 1,300 feet above the lake and must be several hundred feet thick.

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[47] Geol. Sur. Can., 1863-66, p. 127. Macfarlane briefly describes the Huronian rocks near Goulais bay and mentions quartzite.

Half a mile north of McAuley's, as one ascends the pass, felsite schist is observed with a strike nearly north and south and a dip of about 45° to the east. On the steep wooded hillside to the left of the road, coarse syenite gneiss is found in contact with a felsitic rock, probably the same as that seen along the road. The gneiss is not markedly foliated, but seems to strike about 60°. It encloses large masses of felsite and also green schist resembling the Keewatin. The felsite schist just referred to looks very like certain Upper Keewatin rocks of the west, and is not mentioned by Logan as belonging to the typical Huronian. Its exact relation to the graywacke conglomerate at McAuley's was not clear, the intervening ground being drift-covered. The gneissoid rock is clearly eruptive as regards felsitic and also chloritic schists; the latter may however be of earlier age than the main mass of Huronian, and may correspond to the Keewatin-like bands observed in Laurentian gneiss east of Thessalon.

North of Great Gros Cap.

Part of the shore to the north of Great Gros Cap was carefully coasted so as to examine the area mapped there as Laurentian. Rounding the point, which is formed of red Keweenawan porphyry and diabase of unknown age, one finds coarse red granite or syenite, sending dikes into a foliated hornblendic rock, in some places forming a giant breccia. Still farther north, well-foliated gneiss shows on the cliffs and encloses dark lenticular inclusions. The gneiss here dips 40° to 70° to the west. Beyond this the shore consists of low, flat-lying St. Mary sandstone.

At Batchawana Bay.

On Batchawana bay much of the shore near the mouth is of sandstone, but going farther in on the southeastern shore slate conglomerate is found, the sparse pebbles being chiefly granite, though greenstone and quartzite also occur. Bosses of red granite penetrate it. Not far from this, as observed by Professor Willmott, a band of porphyritic granitoid gneiss cuts across the slate conglomerate eruptively, perhaps the band mapped by Logan as syenite. "The gneiss holds angular inclusions of basic schists, the whole sembling the Keewatin contacts o of the Woods." Similar coarse phyritic gneiss appears at a point side of the bay, and there incl schistose hornblendic rocks, the g ing a rough fluidal structure en greenstone masses.

On the north shore of the bay Huronian conglomerate consisting of granite, cemented by a greeni rests against the southern flank of Laurentian hills. The Laurentian slightly porphyritic, gray gneiss. of the conglomerate there is a rock with some quartzitic bands. tact looks eruptive, and the boul conglomerate as far as observ resemble the adjoining gneiss; wh point the rock at the contact is conglomerate. The rock exposur however not clear enough to giv evidence.

A Laurentian Habit apparent.

On the whole the results of ou tion of the Goulais-Batchawana contacts suggest that tl tian here has an eruptiv ship to the Huronian. supposed Laurentian gneiss has studied on a large scale, however, sible that the rocks referred to might be described by another c foliated granites later than both t tian and Huronian. The fact bands and angular inclusions of l closely like the western Keewat cluded in gneissoid rocks of Laure cannot however be disputed. A ample of a typical Huronian roc a quartzite, a jasper conglome graywacke conglomerate, bein eruptively in Laurentian gneiss h observed by us in the region; th cases have been found of what ap eruptive contacts between Laurent gneissoid rocks and rocks that ap true Huronian, one near McAuley on the south side of Batchawana b third on the north side.

The Huronian of Dore Rive

Logan found several areas of H the north shore of lake Superior an

Features of the Doré River Section.

ial attention to the rocks of Doré (or Pickerel) river, five miles west of the mouth of Michipicoton river. He gives an elaborate section of the slate conglomerates which occur there, describing them in detail up to a thickness of 1,700 feet; the rest of the series, in all several thousand feet, being too much covered with trees and moss to examine satisfactorily.[48] We employed two or three days in the study of the Doré section, which is a continuation of the Huronian rocks of the Wawa lake gold district. The rock on the shore so carefully described by Logan is a characteristic schist conglomerate such as could be matched at many points in the Keewatin of Shoal lake or Lake of the Woods. The boulders observed are granites most frequently, then quartzites or sandstones with pebbles generally small, next green schists, then felsite schist and porphyroids, and finally a few gneisses, but none of the Laurentian type. In many cases the softer pebbles are greatly flattened and even bent around their harder neighbors. The most interesting of the boulders, or rather pebbles, for they are not often large, are the quartzites or sandstones. They are usually white, but sometimes yellow or brown, are fine grained and often so soft as to be pulverulent. Some of the smaller ones are nearly black and are probably the chert-like pebbles mentioned by Logan. Precisely similar pebbles occur in the Keewatin conglomerate of Shoal lake near Rainy lake; and the parent rock must have been such a sandstone as that of the Couchiching near Fort Frances. It is interesting to note that Professor Willmott found bands of such sandstone two or three miles to the east on Little Gros Cap, near a deposit of iron ore. Very seldom a boulder of conglomerate occurs, the ones examined having the look of schist conglomerates. They are well rounded and somewhat flattened, like many other of the boulders adjoining. Two specimens collected may be described. One is six inches long by two inches in thickness, and consists of pebbles of felsite or felsite schist, yellowish to greenish in color, imbedded in a darker paste containing some smaller rounded fragments of the same rock. It seems to be a water-formed conglomerate, not an autoclastic rock. The other boulder when complete was about a foot long, but less than two inches thick, once well rounded but now rolled out somewhat flat. It consists of small pebbles of the bluish or white sandstone mentioned above, and of glassy quartz with a small amount of chlorite schist as cement.

The sandstones are distinctly stratified rocks, under the microscope often but not always showing a structure of grains having brownish or dusty partings from one another. Dark colored ones contain many black particles attracted by the magnet. A few scales of green chlorite are scattered through the quartz. One thin section contains a considerable amount of a carbonate. The other varieties of rock occuring as boulders do not require a particular description.

Off the shore from the mouth of Doré river are a few small islands of the same conglomerate. Including these, we made the width of the band of conglomerate about 2500 feet by micrometer. As the dip ranges from 70° to 90°, the thickness of the band is not very much less, so that the 1700 feet given by Logan may be increased by more than a third.

Doré river is very difficult to navigate from the succession of falls and flat rapids which it forms as it approaches lake Superior and was ascended about two miles only. The conglomerates continue along the crooked river for 2,200 feet, and allowing for curves this gives about 650 feet in addition; so that the whole thickness of conglomerate cannot be less than 3,000 feet. Beyond this the rocks observed are mainly felsite schist with some green schist interbedded and a little very fine grained gray gneiss at one point, all having a strike about east and west or parallel to that of the schist conglomerate, and a nearly vertical dip, the lowest inclination observed being 75° to the south. The distance across the strike examined by us was about 1¼ miles inland from the conglomerate. The rocks found can all be matched in the western Keewatin, none of them having any similarity to the typical Laurentian. The gneissoid rock mentioned is very like some of the Rainy Lake Couchiching. The felsite schist here described probably represents the "reddish yellow felspathic layers" of Logan; which caused him to say that "towards the lower part it assumes more the character of the gneiss which usually succeeds it." Neither Logan nor ourselves examined the inland boundary of the Huronian.

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[48] Geol. of Can., 1863, pp. 53-54. See also Macfarlane, ibid. 1863-66, p. 127.

Extent of the Dore Conglomerate Band.

As shown in an earlier part of this report, Prof. Willmott has followed the Doré conglomerate four miles east, almost to the peninsula of Little Gros Cap, with practically the same strike as at Doré, and in the gold region several miles farther to the east he has found areas of schist conglomerate which probably form a continuation of the Doré band. About a mile west of the river the schist conglomerate is penetrated by masses of diabase and greatly crumpled, the pebbles being rolled out thin, and fragments enclosed in the eruptive rock show vague outlines fading into the diabase as if partly fused. Beyond this point felsite breaks through the conglomerate, disturbing its strike and making the pebbles almost indistinguishable. Still beyond these is red granite, perhaps the parent mass of the intrusive felsites. Farther west along the shore large masses of schist conglomerate were seen enclosed in the granite, one containing a boulder of actinolite schist three by one and a half feet in dimensions. The largest mass of conglomerate is about 50 by 100 feet.

At Denison falls, near the mouth of Dog river, schist conglomerate again occurs, having a strike of 140° and dip of 80° to the east. These rocks have a more felsitic matrix than those at Doré however, and may not represent the same band.[49]

Conglomerate is found again near Eagle river and between Pilot harbor and Pucaswa river, in the latter instance running as a narrow band for 1½ miles along shore, the rock inland being felsite or porphyrite. It is not improbable that originally a band of conglomerate extended along the whole shore from Michipicoton river to a point east of Pucaswa river, a distance of at least 45 miles. The conglomerates being softer than the felsite schists have been eaten away on many parts of the shore, and are interrupted also by eruptive masses of granite and diabase.

The general band of Huronian comes to an end at Otter cove, ten miles beyond the last observed outcrop of conglomerate. The gneiss apparently forms an eruptive contact with the Huronian near Otter head, but there are masses and dikes of granite penetrating both rocks more or less at that point, making the inference somewhat uncertain. No basal conglomerate was found.

Relativity of the Conglomerate.

It is worthy of attention that the Doré conglomerate, like that of Shoal lake, is not basal as regards the Laurentian. It is some thousands of feet above the base of the series of schists in which it is found, and contains no boulders that are distinctly Laurentian, only rocks belonging to the schists generally called Huronian and the eruptives often found in them.

The Doré conglomerate has been somewhat fully described, because it presents a perfect parallel with the Keewatin schist conglomerate of Shoal lake in the west, is like it in every way so far as general appearance, lithology and the steeply tilted position of the bedding are concerned, and yet is unhesitatingly placed in the Huronian by Logan. If this area is Huronian, as asserted by the founder of the system, it is hard to see why the western Keewatin should not also be included.

It must be admitted that the Doré rocks have on the whole a more ancient look than the typical Huronian north of the lake of the same name, and present very few points of similarity to them either from the stratigraphical or the lithological side. There are no jasper conglomerates, graywacke conglomerates nor limestones among them, and the schists which they present are more thoroughly crystalline than any in the original Huronian unless perhaps the chlorite "slate" near the base of that series. On the other hand some of the Doré schists are very like examples of the dark schists enclosed as bands or angular fragments in the Laurentian gneiss underlying the basal conglomerate of the Huronian east of Thessalon.

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[49] The Dog River conglomerate is referred to in the Bulletin of Denison Univ., vol. 2-4, p. 123.

It seems tolerably certain that Logan included in his Huronian two series of rocks of quite different ages, the Huronian of lake Huron being probably much younger than the rocks so named on lake Superior. This conclusion is in agreement with Lawson's view, in accordance with which he gave the name Keewatin to the Lake of the Woods schist,[50] and compared them with the Doré rocks, distinguishing the latter from the original Huronian.

Schists of Heron Bay.

On the Shores of Heron Bay.

Another large area of schists mapped by Bell as Huronian, but not described by Logan, occurs 35 miles to the northwest around Heron bay, where the Canadian Pacific railway first touches lake Superior. Two days were devoted to a study of these rocks on the shores of the bay and along the railway to the west between Huron bay and Peninsula.[51] These rocks are first met at the point turning northward from Pic river to Heron bay, where they consist of green schist and felsite schist with variable strike and dip, probably from the influence of the adjoining eruptive gneiss or granite which sends dikes into them. Rounding the point one finds schist conglomerate with a strike of 110° to 120° and a nearly vertical dip. These rocks are greatly sheared, so that the forms of the pebbles are almost indistinguishable except where lapped by the waves. A little way off they look very gneissoid. The conglomerate contains pebbles and boulders of all sizes up to blocks two feet long, mainly reddish or yellow granite or quartz diorite or porphyry, and green and dark gray basic rocks and schists. The matrix is generally dark green and more easily weathered than the boulders. In most cases the pebbles are considerably rolled out, and in parts they show only as bands of slightly varying color, or turn to felsite schists in which no pebble can be seen.

The strike and dip vary greatly, the former from 60° to 120° with an average of about east and west; and the latter from 40° or in one place 30° to the north to verticality. The breadth across the strike is about four miles, from the point turning towards the mouth of the Pic to the railway station; and the distance followed along the strike is about 2½ miles. Going towards Peninsula the schist conglomerate is followed by green-gray, very fissile slate or phyllite, then a band of felsite schist with faint traces of flattened pebbles, then a band of dark gray slaty rock, a series of hard green agglomerates and near the Peninsula gravel pit by a large eruptive area. All the schistose rocks have dips running from 45° to the north to vertical. They are however a good deal disturbed by dikes of both acid and basic rocks. Whether the slates are lower or higher in the scale than the schist conglomerate was not settled. The unusual width of the conglomerate beds is worthy of remark. It may result however from close folding and not represent a continuous sequence of beds. The schistosity conforms in general to the bedding as shown by the bands of more numerous and less numerous pebbles. The rocks just described conform to the Keewatin rather than the typical Huronian type.

Impressions as to the true Sequence of Archæan Formations.

The general impression left by our summer's work in the region is that Logan has included two series of rocks of very different ages in his Huronian; that the series on lake Huron, the most carefully studied and the only one mapped in detail, is of later age than the Doré rocks and probably also than the western Keewatin (or Ontarian); and that in the typical Huronian region the Keewatin is probably represented by the bands and fragments of green and gray schists enclosed in the Laurentian gneiss and granite. If these impressions are correct the true succession in time is Keewatin, Laurentian, Huronian; the term Laurentian being confined to the areas of granite and granitoid gneiss corresponding to the Ottawa gneiss of eastern Canada, and having eruptive relations with the Keewatin. The suggestion just made implies an immense lapse of time between the Keewatin and also the Laurentian and the overlying Huronian. The gap between the Keewatin and the Huronian was long enough to permit of the Laurentian gneiss erupting through the Keewatin rocks, and throwing them into closely folded synclines; after which the granite and gneiss consolidated at great depths and the whole mountainous region was carved down to a peneplain. On this the basal conglomerate of the typical Huronian was deposited.

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[50] Geol. Sur. Can., 1885, cc.

[51] Geol. Sur. Can., 1870-71, p. 328. Bell mentions "slate conglomerate" with dark green trap as the rocks east of the mouth of Pic river, but does not describe them.

The basal complex recognized everywhere as underlying the ordinary sedimentary rocks is considered by us to consist of two very distinct groups of rocks of quite different ages, the older one mainly of basic green schists but including also immense beds of schist conglomerate, the later one consisting mainly of moderately acid eruptives.

The Keweenawan Series.

Characteristics of the Series.

In the field covered by last summer's work the Keweenawan, Logan's Upper Copper-bearing series, includes many basic eruptives such as diabase and amygdaloids, some acid eruptives such as quartz porphyry, quartzless porphyry and felsite, and also sedimentary rocks such as sandstone, shale and conglomerate; in fact, most of the rocks described by Irving as occurring in the Keweenawan of the United States.[52] One variety of conglomerate, basal and made up chiefly of the underlying Laurentian rocks, has apparently not been found south or west of lake Superior, though not uncommon on the northeast shore. As a very full list of authorities on these rocks is given by Irving it will be unnecessary to refer to them in detail here. The northeast shore Keweenawan has been described more or less fully by Logan,[53] Dawson and Macfarlane and needs no lengthy account.

Localities of the Keweenawan on Lake Superior.

Following up the shore from Sault Ste. Marie, rocks of this age are first seen at Gros Cap, where red quartz porphyry rises through the Laurentian, interesting from the fact that it has carried up in its eruption fragments of coarse quartzite, no doubt belonging to some Huronian bed beneath. Round the point a patch of typical amygdal against the foot of the Laurentian ma the same rock occurs at three points east side of Batchawana bay. The the northeast of this bay seems to siderable, a range of hills of amygdal ning east and west for some distan one point a small patch of green am is seen to form a breccia, ramifying the granite blocks at the point tact.

Next comes the large area of Mam fully described by various writers be the copper mines located upon it. A loids occur once more on the north Pointe aux Mines, and connected wit basal conglomerate or breccia co large boulders of gneiss or granite the bottom of the series.

Beyond this for some distance stretches of Keweenawan are found, these rocks once occupied the reg probably still exist beneath the lake by occasional patches of the basal c erate filling old chasms of the Lau As their greenish cement is soft, t glomerates are more readily acted waves than the Laurentian rocks and the Keeweenawan shore line i restored by the waters of the lake, cient boulders being set once more after their long rest.

To the south of Gargantua there are red shaly rocks with numerous cav most like amygdaloidal openings, and extremity of the cape amygdaloids directly on gneiss without the usu conglomerate.

Beyond this, undoubted Keweenaw were found only at two points, betwe harbor and Pucaswa, nearly north o picoton island; and at Swallow rive 15 miles northwest; in both cases r of basal conglomerate preserved by been deposited between Laurentian narrow ravines. Each of them brownish-purple ground mass more crowded with granite and less often pebbles.

It is probable that many of t numerous diabase dikes to be found this shore are really of Keweenaw

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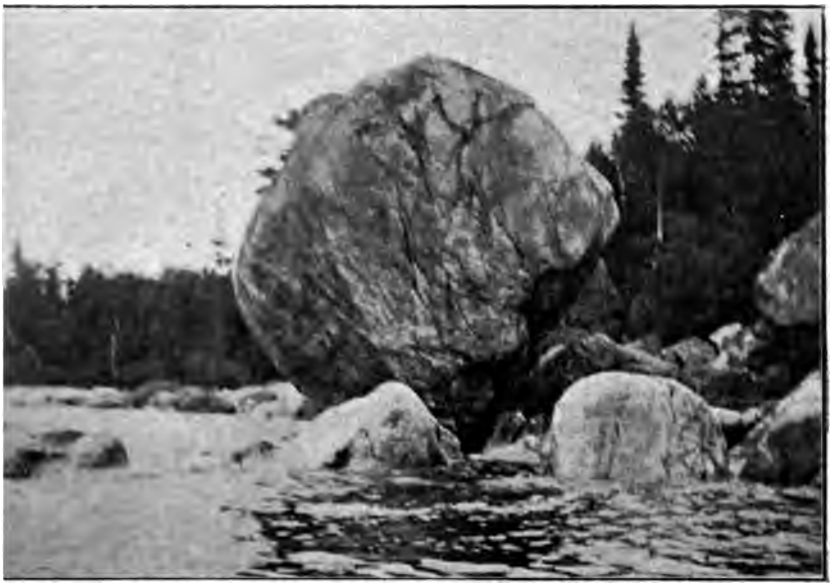
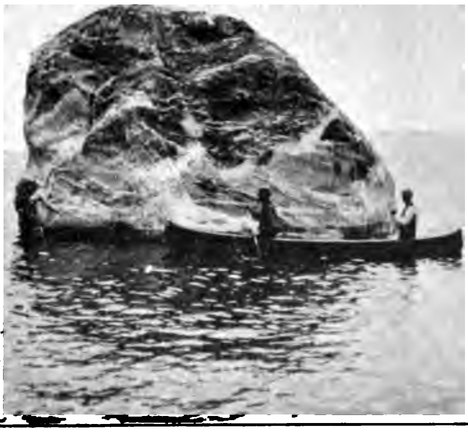
[52] Copper Bearing Rocks of L. Sup., U. S. Geol. Sur., 1883.

[53] Geol. Can., p. 67, etc., Logan; Can. Nat. and Geol., vol. II., 1857, p. 1-12, Dawson; Geol. Sur. Can., 1866, 115-148; Can. Nat. and Geol., 1866-8 (2), vol. III., pp. 177-202 and 241-257; and also 1879 (2), vol. IX., pp. 91-102, Macfarlane.

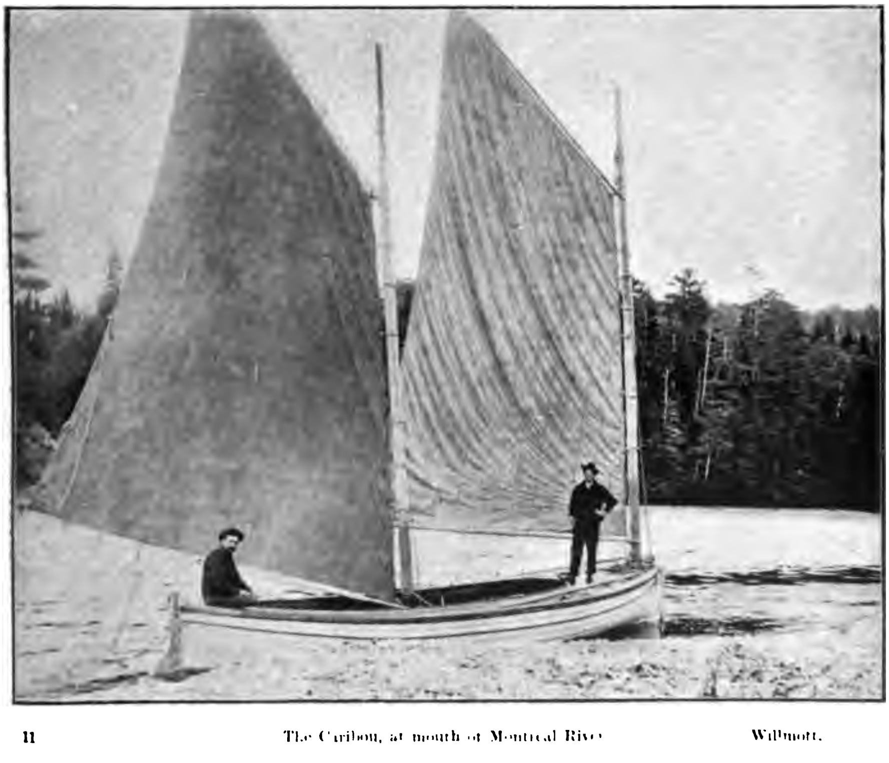


Remnant of a Dike north of Pointe aux Mines, Lake Superior, 15 ft. high. - Willmott.



Boulder near Shore, two miles north of Point aux Mines, Lake Superior (canoe 16 ft.). Willmott

Gravel and Sand Bar at mouth of Dog River, Lake Superior. Length of Bar on lake side ¾ m., width at centre 140 ft. An old Channel lies along the base of the wooded hill in rear. Willmott.



The Caribou, at mouth of Montreal River Willmott.

Denison Falls, two miles up Dog River, showing the lower part of the main Fall. Willmott

12 An eroded Dike north of Spruce Harbor, Lake Superior: 200 yds. long, 25 feet wide, and 10 to 20 feet deep. -Willmott

this is hard to prove. Some of them however are of greater age, since Keweenawan basal conglomerates ɔon Laurentian and diabase dike alike, ıtain boulders of the latter.

dikes of the region are distinctly of nds, one with pronounced columnar re, the other without. It is probable e columnar dikes are of Keweenawan ınd the others older.

splendid series of basic and acid rocks hipicoton island have been described gan and Macfarlane; and thin sec- f them have been studied by Irving, nothing need be said of them here.

Notes on Petrography.

ng the summer numerous rocks of raphic interest were collected, particularly eruptives, and the petrographic characters of the more important ones will be briefly described. Some of the eruptives ɔeds interstratified with the sedimen- cks of the Huronian and of the Ke- ɤan series, having been contemporary ɔws, as proved in some cases by the ce of amygdaloidal layers. In other he rocks form large masses which have d through the Huronian sediments; many instances specimens have been ed from dikes, generally of later age he Huronian.

ɔtives connected with the original ian region will be taken up first; then ves belonging to the Keweenawan; nally eruptives associated with areas d as Huronian on the north shore of uperior.

ruptives of the Original Huronian.

ɤ two undoubted sections of eruptives ɔdded as contemporary lava flows in the series of Huronian clastics have been studied, both from near Thessalon where dark green diabase numerous beds separated by amygda- layers. They are very fine grained, ɔpear to be connected with ash rocks ɾglomerates of the same composition towards the east. The amygdules netimes large and scattered, at others ınd crowded. The filling is usually dark green serpentine, in large amygdules sometimes enclosed by a band of epidote. Chalcedony and calcite occur only sparingly. In thin sections the amygdules show as pale green areas, at times with concentric bands of radiating fibrous serpentine showing dichroism. With crossed nicols no double refraction is observed except in the radiating fibrous layers which show pale violet when not parallel to chief sections of the nicols. The rock as a whole is greatly weathered, but the tiny lath-shaped felspars are still readily seen giving a characteristic ophitic structure. The only other minerals recognizable are magnetite, serpentine and a little green hornblende.

Diabase at Bruce Mines.

Eruptive masses both basic and acid are common in the original Huronian, and wherever examined by us appear to be of distinctly later age, showing eruptive contacts with quartzite, etc. Of the basic rocks two diabases may be referred to, the first the mass in which the well known copper-bearing veins of the Bruce Mines occur. This mass was looked on by Logan as being interbedded, but our observation of eruptive contacts near Bruce Mines indicates the contrary. The diabase at Bruce Mines is being quarried as road metal for use in Cleveland, Ohio, so that fresh specimens are easily secured.

The rock is dark green gray, of medium grain, with a distinctly ophitic structure. There are a few plagioclase phenocrysts of dull green color. Under the microscope the felspars, which are quite fresh, show a complicated twinning zonal structure, and extinction angles suggesting labradorite. In spite of the rather basic felspar there is an appreciable amount of quartz present, partly as small blebs but mainly as micropegmatite radiating in delicate intergrowth with felspar from well formed crystals of the latter mineral. The augite is mainly weathered to dull green hornblende, and this with a little brown biotite and some magnetite form the rest of the rock.

A hill rising several hundred feet not far from the north end of Great Lake George consists also of diabase, but much more weathered. A thin section shows a larger amount of quartz with a coarser intergrowth as a rule.

An Area of Grano-diorite.

A large area of rather dark red rock, coarse grained and syenitic looking, occurs between Thessalon and the Cheney copper mine near Mississaga river. Under the microscope it proves to contain a considerable amount of quartz, having a rough intergrowth with felspar ; orthoclase in small amounts, often having very long and slender microperthitic inclusions ; plagioclase with narrow twin lines and low extinction (oligoclase), quite often with long prismatic forms very well shaped. Dark brown highly dichroic hornblende and also pale green secondary hornblende occur in considerable amounts, and a little biotite and magnetite. The plagioclase felspar distinctly outweighs the orthoclase, though the rock has the look of a syenite or granite. It may perhaps be called grano-diorite.

Dikes in the Limestone.

Several narrow straight dikes cut the limestone band on Echo lake, standing up an inch or two above the surface, since they resist weathering better than the enclosing rock. Two of these dikes are only from one to five inches wide, but distinctly coarser grained in the middle, where also a few tiny fragments of jasper are enclosed in the black matrix. A thin section shows a dull grayish brown ground mass, with a few brightly polarizing needles which seem to be of augite, not of plagioclase, from their high double refraction. The ground mass was probably glass at first. There are white spots of some secondary mineral with quite high colors between crossed nicols, and a very few phenocrysts, one of olivine turned to serpentine, others of augite. The rock may be called a weathered picrite porphyrite.

A larger dike is 33 inches wide and shows a curious banded structure, at the edge very fine grained, then growing gradually coarser with white or honey-colored spots like amygdaloids. Then an inch of black fine grained rock followed by a few inches of amygdaloidal rock again, with a fine grained black strip in the middle. Beyond this the arrangement is reversed, giving a ribband-like look to the dike. It is probable that the fissure occupied by the dike has been opened several times, splitting down the only partially cooled middle and allowing a fresh flow of molten material. The only specimen taken was from an amygdaloid
Under the microscope one finds muc
some of it in slender strips, a larg
of brown biotite in distinct phe
often with browner margins, and m
The finer grained parts of the
vaguely doubly refracting and per
present devitrified glass. No plagiocl
be found, nor anything looking li
composition product of it. The a
are filled with a dirty white minera
double refractive or not at all so, pr
zeolite. No olivine was distingui
that the rock may be named an amy
biotite pyroxenite. It may be how
the apparent amygdules are the resu
replacement of a former mineral,
rock should be described as pseudamyg

Keweenawan Eruptives.

Basic Eruptives at Mamainse.

A large proportion of the Kew
rocks at Mamainse and on Mic
island are basic eruptive
have been poured out as la
having many layers of amy
between beds of diabase. Some of t
black glassy rocks, pitchstones ; othe
coarse grained. Most of the basic e
so elaborately described and figured
occur in our region, and a portio
specimens came from Michipicoton.[5
to the completeness of Irving's
much time has been devoted to
eruptives, and only a very few will be
to here.

A quite coarse grained diabase
part of the country rock of the ve
main shaft of the Sand Bay copper
of interest because of the peculiar
ment of the radiating fibres of pa
serpentine filling certain spaces,
pseudamygdaloids, between the othe
als. Some of these radiating ma
spherical and show a very distinct bl
in polarized light, but the arms of
are not straight. Each arm is a li
near the centre, giving a form sugge
"swastika" as figured by ethnologi
other masses the concretion is not ro
elliptical, when the arms of the cros
equally spaced, having an X form.

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[54] The Copper Bearing Rocks of Lake
U. S. Geol. Sur., 1883.

A variety of diabase or melaphyre like that gured by Irving[55] and described as consistıg of large augite anhedra crowded with icrolites or small laths of plagioclase, and eparated from one another by more easily ecomposed material, originally glass, is very ommon at Mamainse. The rock weathers apidly in the interstitial parts, leaving the ugites as fine gravel formed of rounded agments of the size of peas or beans. His escription applies to our rocks with the one ception that no olivine has been observed the latter. The interspaces between the gites, which are quite fresh, are filled with own iron oxide and serpentine containing hs of plagioclase, but no outlines nor remnts of olivine, so that the rock should be led diabase, not melaphyre.

he glassy variety of the Keweenawan nic eruptives has much the look of Lydian ne, and is very opaque, so that sections with difficulty ground thin enough to be nsparent. The rock consists essentially of sh brown glass crowded with slender crolites of plagioclase, and also of augite th many small grains of magnetite. A few ger crystals of plagioclase are to be found, nerally having inclusions of glass. The k closely resembles in thin sections a laphyre from Goldspitz in Bohemia. It perhaps better called a basic pitchstone.

H Amyg- oids.

The amygdaloids of this age are usually ry badly weathered, so that sections were made of only a few. Those examined have the character of fine ained diabase, generally somewhat porphyic. One contains numerous skeletons of n oxide having the form of olivine crysls, though no olivine remains. This may called an olivine diabase. The amygles, so far as studied, contain calcite, alcedony, pale green serpentine and a ayish, scarcely doubly refractive mineral, obably a zeolite. Native copper occurs in e amygdules, though rarely.

ptives of Series.

The acid eruptives among the Keweenaan rocks include a series of flesh red or dark red porphyries or felsites. The fine promontory of Gros Cap consists mainly of dark red quartz rphyry with many bright red felspar phenocrysts and a few blebs of quartz in a compact ground. Thin sections show that the felspars are largely plagioclase, though sometimes unstriated. Their advanced stage of weathering, rendering them turbid and clouded with particles of hematite, makes it doubtful in many cases which felspar is present. The ground mass is made up almost wholly of an intergrowth of quartz and felspar, chiefly unstriated so far as can be determined. This intergrowth is of a peculiar character. Sometimes a quartz area is filled with separate small felspars not always oriented alike, forming a poikilitic structure. At others the quartz forms slender ramifications suggesting frost work, in a mass of felspar that seems to be continuous. Larger quartz portions may branch off into this structure. Some parts of the intergrowth have the appearance of micropegmatite, and perhaps the whole of it might be brought under that designation. The rock in that case may be called a micropegmatite porphyry. Irving describes and figures somewhat similar rocks from Michigan,[56] and regards the quartz as secondary, saturating the rocks and sending projections into the felspars. As practically the whole of the rock consists of this intergrowth, and from $\frac{1}{3}$ to $\frac{1}{2}$ consists of quartz, this theory demands too much. It is very improbable that $\frac{1}{3}$ of the weight of the rock could be introduced from without in the form of quartz and so uniformly disseminated as we find it. The more likely explanation is that the magma, in which a few crystals of felspar and still fewer blebs of quartz floated, having much more than the right proportion of silica to form felspar, consolidated into micropegmatite. That there are secondary micropegmatites is probable, but in this case it is more reasonable to look on this widespread intergrowth as primary.

Porphyries and Felsites.

Handsome specimens of quartz porphyry as well as quartzless porphyry are found on Michipicoton island, and several have been studied. They show a similar intergrowth of quartz and felspar in the ground mass, though much less elaborate and striking. The porphyritic felspars observed are mainly striated and have the

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Copper Bearing Rocks of Lake Superior, pl. ix.

[56] Copper Bearing Rocks of Lake Superior, p 112, etc.

characters of oligoclase. Flesh colored felsites occur in considerable quantities at Mamainse, but the specimens obtained do not differ materially from those collected by Mr. Blue at the same locality in 1893 and described in his report for that year.[57]

Dike Rocks near Heron Bay.

Dikes in the Schist Conglomerates

The Heron Bay schist conglomerates, which may be considered of Keewatin age, are penetrated by a number of dikes well displayed in the railway cuttings west of the station. Thin sections have been made of a number of these, and a few of the more interesting will be described. A dike several feet wide of very dark gray diabase porphyrite is of interest as showing very well the transition from the edge, which is exceedingly fine grained with some devitrified glass, to the coarser grained diabase in the center. Large and fresh tabular plagioclases form phenocrysts in each and a few porphyritic augite crystals occur in the marginal part of the rock.

Besides the diabase dikes there are several varieties of acid dike rocks, some of an interesting kind, which will be briefly described, though some points in connection with them are not yet fully worked out.

One large dike is of grayish flesh colored quartzless porphyry, having a microgranitic ground consisting of quartz, orthoclase, plagioclase and muscovite, and large very well formed crystals of felspar, mostly plagioclase though a few unstriated crystals sometimes Carlsbad twins occur. The plagioclases have extinction angles indicating andesine or labradorite.

[illegible] Heron Bay [illegible]

[57] [illegible]

and serpentine, so far as determir
between the roughly spherical felspa

A new Analcite rock.

A dark brownish red dike, well
at a cutting near mile 804, west of H
station, shows less perfect
structures, probably of
faintly polarizing and crowded with
of red iron oxide. The rays are few in
not feathery, and have a low angle
tion from edges of the narrow lat
crystals, in many cases not distin
from parallel extinction. With an i
lens some of these felspar laths are
into strips having slightly different
extinction, as if oligoclase. In th
ground there are some wider plates
felspar, not observed to be striated
are also imperfectly radiating gro
green mineral, having a distinct di
green and yellowish green, and brig
izing colors. The mineral was at fi
for hornblende, but most of the pri
parallel extinction, or only a v
angle of extinction. The latter
suggests that the mineral is ægi
the crystals are too minute to be s
for special examination.

The most interesting feature of
is the large amount of glassy grou
enclosing the radiating structures.
appears to be quite isotropic it wa
held to be glass. It is free from th
ish particles of many volcanic gla
resembles some acid pitchstones.

Under high power this basis prove
delicate but well marked cleavag
crossing at right angles and sugg
mineral of the isometric system.

[illegible] polarized light, much fainter [illegible] parts this [illegible] and basaltic [illegible]

[illegible] Pirsson, The [illegible]

sections to consist mainly of vaguely radiating masses of felspar, apparently not striated, with a smaller amount of dolomite. None of the isotropic mineral is seen in these areas.

Comparative Analysis.

The complete analysis given below was made by Mr. H. W. Charlton, his results being put in column I. In column II an analysis by Dr. Mann of cancrinite-ægyrite-syenite from Siksjö-Berg in Dalarne[59] is given because of its rather close resemblance to No. I; and in column III an analysis of analcite-basalt from the Basin, Colorado, by W. F. Hillebrand.[60]

	I	II	III
SiO_2	52.73	51.04	45.59
TiO_2		.29	1.32
ZrO_2			.03
Al_2O_3	20.05	20.47	12.98
Fe_2O_3	3.43	1.89	4.97
FeO	.99	2.19	4.70
MnO			.14
CaO	3.35	2.62	11.09
SrO			.12
BaO	.11		.13
MgO	.17	.97	8.36
K_2O	4.77	3.52	1.04
Na_2O	7.94	11.62	4.58
H_2O (at 100°)	.69	5.85	.51
H_2O (at red heat)	4.85		3.40
P_2O_5	trace	.27	.91
Cl			.05
CO_2	.93	.62	
	100.01	101.35	99.87
Spec. Grav	2.466	2.46	

A little more than 46 per cent. of the rock remains unaccounted for by the partial analysis; and if we suppose the whole of the potash to belong to orthoclase and the unused portion of iron oxide (1.40 per cent.) to belong to ægyrite, we have left silica, alumina, lime, and soda nearly in the proportions required for labradorite (Ab. 2 : An. 3) though the lime and soda are about one-third in excess of the amount required, the excess being less than 1 per cent. however.

Summing up the results arrived at, the minerals forming the rock have the following percentages:

Analcite	47.00
Orthoclase	28.24
Labradorite	13.00
Ægyrite	4.04
Limonite.	3.59
Calcite	1.96
	97.83

In this computation moisture removed at 100°, unimportant percentages of magnesium and barium oxides, etc., amounting in all to 1.47 per cent., have been neglected.

The composition of the rock as shown by the analysis differs widely from that of analcite-basalt, as may be seen from a comparison of columns I and III, the latter being more basic, containing less alumina and alkalies, and far more lime and magnesia. It corresponds fairly well however to the composition of nepheline syenite, the only important difference being in the amount of water. The syenite from Dalarne, whose analysis is given in column II of the table, having its nepheline weathered to a hydrous mineral, resembles this rock closely in composition, the only important difference being the larger percentage of soda. In their unusually low specific gravity, 2.46, the two rocks are alike.

One naturally expects to find the dike containing the rock above described in connection with some boss of nepheline syenite; but the slight examination hitherto made of the region by Dr. Bell and myself has not disclosed any area of that rock.

A new name suggested—Heronite.

If the analcite rock of Heron Bay had a granular texture, it would appropriately be named analcite-syenite, after the analogy of nepheline-syenite; but its peculiar structure of spherical groups of orthoclase embedded in a ground of analcite containing radiating bundles of plagioclase laths and ægyrite needles sets it quite apart from the syenites. It will probably be wise to give it a separate name, and Heronite, from the name of the locality where it occurs, is suggested as suitable.

Heronite may be defined as a dike rock consisting essentially of analcite, orthoclase, plagioclase and ægyrite, the analcite having the character of a base in which the other minerals form radiating groups of crystals. The analcite clearly represents the magma left after the crystallization of the embedded minerals; and it is evident that it can be formed only from a magma highly charged with water, and therefore under pressure. It is equally evident that Heronite, like other analcite rocks, cannot be an effusive, since under those circumstances the water would escape;[61] and that its nearest relatives among effusive as well as plutonic rocks are to be found in the group containing nepheline.

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[59] Neus Jahrbuch fur Mineralogie, 1884, II, p. 193; as quoted by Zirkel, Lehrbuch der Petrographie, Band II, p. 410.

[60] Whitman Cross, an Analcite-Basalt from Colorado, Jour. Geol., vol. v, No. 7, 1897, p. 689.

Associated with the last rock is a reddish brown rock thickly filled with greenish black spots, looking somewhat like amygdules. It is hard to get thin enough sections for microscope work, and the general mass of the rock is too far weathered to settle anything positively, particles of a carbonate being mixed with brown iron oxide. The spots
like anygdules have deep red rims
oxide, and consist within of dolomite,
and a few portions of felspar like th
tioned in the previous rock. It is
that this rock represents a more con
weathered state of the one mentioned
and that the apparent amygdules a
pseudamygdules formed from the
concretionary spots of the previous

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[61] Cf. Pirsson, Analcite Group of Igneous Rocks, Jour. Geol. vol. IV. No. 6, pp. 686-688.

HE NIPISSING-ALGOMA BOUNDARY.

By William Arthur Parks.

Introduction.

Iay, 1898, I received instruc-
ı Mr. Archibald Blue, Direc-
:eau of Mines, to accompany
Niven, who was despatched
:tend the Nipissing-Algoma
ary line to Moose river. My
ctions were to examine and
›logical features of the dis'rict,
rces, agricultural possibilities
of an economic nature. In
me to cover as great an extent
possible I was provided with
was given the assistance of
ırter of the School of Science,
.e efficient.

·f Nighthawk Lake.

'ty, 20 in number, left Hailey-
ad of lake Temiscaming on
1. On May 23 we crossed a
mile portage to the Montreal
whence a route was followed
ıke, the terminal point of the
irst 120 miles had been run
ı 1896, and it extended a short
of Nighthawk lake. As Mr.
ıpanied Mr. Niven on that
:ount of this region may be
ıort. Two weeks were spent
point, via the Montreal river,
n and a chain of small lakes
river to the southern point of
.

taries of the Lake.

iver below the portage is a
of from one to two chains in
expanding in places into
:s of considerable extent. Its
and clad with scrub spruce
assing into poplar near the
sures are seen on the river, but a massive green diorite crops out on the lake shore to the west of its mouth. This rock shows distinct glacial striae s. 15° E. and is overlaid by eight to ten feet of stratified clay.

From this point to the mouth of the Redstone river the lake shore presents, in places, bluffs of stratified clay rising as high as 40 or 50 feet. Its continuity however is interrupted by numerous deposits of fine sand, which appear to occupy denuded valleys in the clay. Occasional outcrops of rocks are seen on this western shore, consisting of more or less altered diorites interstratified with fine grained quartzose schists carrying pyrite. One and a half miles north of the mouth of the Redstone coarse hornblende and mica diorites crop out on the shore. Near this point also occur fine grained gray hornblende schists with veinlets of quartz. Three miles farther north are seen rather hard hydromica schists with veinlets of quartz and showing a pronounced schistosity N. 30° E.

Geology of the West Shore.

About seven miles north of the Redstone river the Porcupine enters from the west, above which stream a long point stretches into the lake, extended by an island. On the north side of this island is a fine grained massive diorite, while to the south occurs a typical chloritoid schist, striking N. 70° W. In addition to these rocks a fine grained crushed granite with pyrite occurs on the small island off the mouth of the Redstone river. From this river to the outlet at the northern extremity of the lake, with the exception of the above mentioned exposures, the shores are clay. High banks of the same material occur directly across the lake, forming the most conspicuous point in the landscape.

Nighthawk lake is very shallow, according to Mr. McLeod, who has spent several years in the region, not exceeding 12 feet in depth. Its waters are very muddy, and had on June 6 *a temperature of 60°. Extensive marshes occupy many places on the shore line, but otherwise its banks are green, being timbered with small spruce, poplar, tamarac and birch.*

Redstone River

The Redstone river enters Nighthawk lake not far from the 123rd post on the boundary. This stream is of brown water, with an easy current as far up as the crossing of the line (two miles); beyond it becomes rapid, flowing over a bed of boulders. No exposures were observed either on the river or on the line in its vicinity.

Porcupine River

Another stream entering the lake from the west is the Porcupine, which has its source in a lake of the same name, lying five or six miles west of Nighthawk lake. The total length of this stream is 30 miles, it is therefore found more convenient to reach Porcupine lake by a portage of five miles, which is broken in the middle by a small lake. The first stretch of this portage starts from the south bank of a small creek entering the Porcupine two miles up. The portage is about two and a half miles long and maintains a general direction of s. 20 w. over level clay soil, very swampy in places and timbered with poplar, spruce and tamarac of moderate size only. About two thirds of the way across is an exposure of diorite followed by fine grained quartz-schist, weathering into white patches owing to decomposing felspar crystals. The lake at the end of this portage is known as Red Willow lake, from the fact that that shrub is abundant on its shores. It has clay banks and muddy water, which is discharged at the north side through a small stream showing evidence of the activity of beaver. A ridge of diorite schist about [illegible] high overlooks the lake towards its eastern end.

The [illegible] rather [illegible]

[illegible]

area a short distance to the southeast. Ten chains below the portage we enter the Porcupine, and two miles down pass into the lake.

Porcupine Lake.

Porcupine lake is two and a half miles long and a half to three-quarters of a mile wide. Its shore line presents several exposures of rock ; on the north side occur outcrops of a soft soapstone-like rock, with crystals of magnetite and veinlets of chrysotile. Under the microscope this rock appears to be made up of indistinct fibres of this mineral mixed with quartz. It is evidently a much altered example of the basic eruptive series. A creek of a very tortuous course flows in from the southeast; on it occur exposures of a gray to white quartz schist, weathering quite white with streaks of quartz and pyrite. Considerable birch and pitch pine are found on this stream. A rocky point of some elevation is seen on the south side of the lake, consisting of altered diabase and gray schist, with asbestiform partings and veinlets of quartz. An overland trip south from this point shows that the rock disappears as soon as the water is left, the country being low and wet, with tamarac, spruce, poplar and cedar.[1] This latter tree obtains a diameter of 14 to 20 inches in this vicinity, and appears to be plentiful. The temperature of the water in these swamps was 36°, while in Porcupine lake it was 58°.

Rocks on the Porcupine River

On leaving the lake Porcupine river flows through a marsh half a mile in width and bends northward for 15 miles. It then turns east and south, and crosses the line at 130 miles and 66 ch. It is navigable throughout, but several short portages are required in the upper stretches. The following outcrops of rock [illegible]

[illegible] altered diabase with [illegible] green chloritic schist.

[illegible] gray [illegible] schist.

[illegible]

[illegible] small rapids over [illegible]

[illegible] with bands [illegible] vertical.

---

[1] That this [illegible] and gives place to rocky ridges [illegible] has since been ascertained. An account of these outcrops will appear in a future [illegible]

distance west of the 29th mile post rop of diorite, associated with schists :ontaining seams of quartz, which gave on assay a minute trace of gold. The only exposures seen on between Redstone and Porcupine re two bands of schist near the t. With this exception the line level clay district thickly wooded ıce, poplar, tamarac and a little ; none of any considerable size. ı features are dominant along the ı river and along Nighthawk lake. ıs in this region would make excellent land, particularly near the lakes s. The country inland is much ıd I am inclined to believe increas- ı respect farther to the west.

›rick House Lake and River.

er from Nighthawk lake flows al- north a distance of six or seven miles to Frederick House or Hollow Sand lake. It is about two chains wide and is unbroken by any rapid. ›p occurs on its banks or on the › of Frederick House lake until we utlet at the northern end. Here ures of diorite and diorite schist ›tzite. The eastern shore is less cted by clay and sand, and outcrops ıumerous, the following series being from north to south :

half miles from the north end, fine-grained ith pyrite, striking southeast and dipping 30 the vertical.

ı half miles down are fine dark-gray schists of pyrite and a coarse green rock, apparently :hic. This dark schist shows a banded spher- ing and seems to consist of nuclei of a jasper- enclosed in the darker bands. This passes linary gray and white schists. That these t least in part, of volcanic origin is well shown

Frederick House Lake.

:k House lake is of much the same as Nighthawk, but contains fewer ke the latter lake it is very shallow, ters have the same turbid appear- he Indian name is Wanatangua, Hollow Sand. I am inclined to ; this name is derived from the fact lay shores are covered in places by sand which gives way on being pressed by the foot. The southern and eastern shores also are overlaid by extensive deposits of clay. These are interrupted by areas of sand both to the north and east, where gravels and glacial accumulations begin to occur.

This lake is subject to violent storms from the east and southeast, the evidence of which is seen in the fallen trees and scarped clay banks on the western shore.

The Inland Region.

The country inland from Frederick House lake was examined by means of a series of portages running west from a point four miles north of the mouth of the river from Nighthawk lake. They join a succession of small lakes, for the most part of beautifully clear water, notably the second, which is known as Clearwater lake. These portages all traverse high, sandy and burnt hills, consisting of very coarse sand with Huronian and Laurentian boulders. Some deep depressions resembling kettle holes are seen on the third portage. By level, Clearwater lake is 60 feet above Hollow Sand, while the intermediate pond is only five feet up.

The last lake of this chain is Ice Chisel lake, which has sand for its eastern and northern boundaries but falls into clay flats to the south and west. For a mile and a half east of the lower bulb of this lake the country is sand with some pitchpine, broken in places by muskegs. A two and a half mile trip from this lake to the west reached the line at the 135th post. This trail crosses a rough and wet country of tamarac and spruce, broken by a single ridge of burnt sand 20 chains inland. The line traverses a similar country, alternating from half dry clay land to very wet muskeg. West from the 136th post the swamp increases in wetness and finally becomes impassable ; a typical bog.

Frederick House River.

Descent of the River.

The water of Frederick House lake passes out at the north end by a river of the same name. It is two or three chains wide at the head, with an easy current. About a mile and a half down, it bifurcates around an island 40 chains in length and continues a little west of north to the first falls, about seven miles down. A barrier of rock crosses here N. 10° E, causing a succession of cascades with a total descent of 46 feet. An island divides the river, and, in all, it may be said that there are three tiers of three cascades each, with a total width of five chains. A rather steep portage of three chains on the east enables us to pass the obstruction. The rock at this point is a much altered porphyrite weathering in white patches, and a fine gray homogeneous siliceous schist. Below the falls dioritic and basaltic rocks occur, of which a much altered example shows decomposed felspar crystals surrounded by chlorite. On the east side this ridge follows the river up stream for a half mile, when it becomes less pronounced.

Northeast from here the land gradually falls to low swampy flats, with almost impassable windfalls. Southwest a ridge occurs on the shore, followed by a valley and a second ridge of clay soil well timbered with poplar, spruce, birch and balsam. This is succeeded by a muskeg with scrub spruce and tamarac.

Below the falls the river holds a course a little west of north, receiving a tributary two miles down. This stream is ten feet wide and flows from a lake a short distance to the west. A trail from the river to the northwest leads past the lower end of this lake to another beyond, crossing the line at 47 chains on the 146th mile. This latter lake is doubtless in connection with others to the west. On its shores occur some beautiful sulphur springs. In this district fair sized poplar and spruce are abundant and the land is quite dry. As may be seen on the map, several other small lakes are scattered over this region, all of which are connected by trails giving evidence of their use as hunting grounds. From signs observed, otter, fisher and beaver must be abundant in this region.

Below the above mentioned creek the river turns to the east of north, until its navigability is interrupted by three bad rapids at a distance of four miles from the falls. The first of these is passed by a portage of a chain on the west side. The fall in this rapid is five and a half feet over a rock composed almost exclusively of serpentine impregnated with much magnetite. The second portage of a half chain is also on the west side of a western division of the river, around an island. The fall is only two feet, but it is much too rough to be run. Five chains below is the third rapid of 30 chains, with a fall of 14½ feet. The portage here is also on the west side and is somewhat hilly. The rock at all these portages is the same as that described at the falls. The direction of the river is about north, but it is hard to determine as a compass is almost useless owing to the presence of so much magnetite in the rock.

Below these rapids rock outcrops are more common than on the upper river. A ridge of white weathering fine-grained schist causes a small ripple about 50 chains down. This is easily run as the fall is only one foot, but small canoes can make a lift-out over the rock on the easterly shore. Below this ripple there is an outcrop of dark highly hornblendic diorite on a small island. Two small tributaries enter from the west, and a little lower a considerable creek of 20 feet from the east. This was followed southeast for a mile, but was found to be jammed with driftwood. Besides small streams, a large creek enters from the west two miles below this one. The water of this creek is very brown and dirty, while its banks show numerous otter slides. It also is choked by debris 60 chains up. A mile below this stream the line crosses at the 157th mile post. Near here a tributary of one chain enters from the east. It has clay banks with evidence of high water two feet above the ordinary level. The river continues a little west of north for four miles more, when it is again broken by a long rapid over coarse gray mica schist with garnets, passing into granite, and beyond into Laurentian gneiss. This evidently represents the Laurentian contact and the end of the Huronian belt thus far traversed. The probable direction of the contact is N. 60 W. as the gneiss shows a general schistosity in this direction. From this point to the mouth of the river, a distance of 23 miles, gneiss is the only rock observed. The first ten chains of this rapid at the contact is easily run to a portage of 15 chains on the east side. Below this rapid is three miles of swift water to another rapid

The Huronian Laurentian contact

n or eight miles of river is
ous rapids, but can easily be
d canoes, excepting the point
e" on the map where a port-
side over the rock is neces-
passage. The river is very
d the fall about ten feet over
mica schist. Trips at this
e existence of fair sized spruce
inland. Twenty chains lower
chains may be run down by
middle, or ascended by hug-
e and poling. Another 20
s to a small ripple easily run
In the next four miles there
ll islands, while the current
easy to a fall of three feet,
middle by an island. The
an be run with care, and it
ed by passing a line on the
outcrops of gneiss and mica
this point. A small creek
bed of boulders below this
lo several others. The river
ection a little west of north
rrent for five miles, when it
Abitibi river at the big bend.
e Frederick House river has
e or four chains.

ouse Lake to Abitibi River.

ion now turns back from
se river to the lake at its
. East of Frederick House
nd in connection by a narrow
s a lake of about two miles
ngth known to the Indi-
quitchwanook or "The-lake-
ns-both-ways." The barrier
two lakes is composed of
ations and coarse sand. The
aller lake are of sand, covered
e and poplar and a few red
The water of this lake is
an that of Hollow Sand, and
lentiful. It seems to be the
or the Indians of the region,
places were noticed on its

enters from the southeast,
e up which is the head of
s. 30° E. to a clear lake with
s water and having its shores
composed entirely of sand. From this lake a portage leads southeast for about two miles over a level sand upland with small pitch pine to a second lake about one-half mile long. South through this lake brings us to another portage of two miles over similar country, but with the pitch pine in part replaced by small spruce. This portage constitutes the height of land separating the waters of Frederick House river from those of the Abitibi. The route then crosses a small pond of 15 chains which receives some beautiful springs of ice cold water. Leaving this lake the trail turns northeast and traverses 60 chains of heavy poplar and spruce timber, then passes into a burnt area for about the same distance. Beyond this the trail makes an abrupt descent of about 60 feet, and passes through 60 chains of low, very wet spruce swamp, extremely difficult to portage over, ending in a small pond of 15 chains. Besides the lakes mentioned there are in this sand area numerous sheets of water of small size. A creek which the route follows flows out of the southeast corner of the last mentioned lake ; it is very tortuous and narrow in places, having however a general width of 10 or 15 feet, and a depth of five feet. This stream traverses a low-lying tract, in places very swampy. The river bed itself is almost choked at intervals by a dense growth of alder and other marsh shrubs. In a straight line the distance to its mouth is three miles, while its total length is eight or ten. Through a large marsh this river enters an open lake two miles in length by one in width, with brown water of no considerable depth. The shores are low and swampy for the most part, but a point on the east side contains many boulders of Laurentian origin imbedded in a sandy clay matrix. The river out of this lake rises in the northeast angle ; it is 30 feet wide and flows southeast for a short distance, when it turns north and maintains that direction with uninterrupted navigation for 10 miles. Throughout this stretch the shores are low and somewhat marshy, with ash, poplar, tamarac and spruce in clay soil. Farther down, the river is badly choked with driftwood, in many places, making the navigation very difficult. About 12 miles down occurs

a small rapid over Huronian schists, the first outcrop on this river. A mile down is another rapid requiring a portage of 10 chains on the west side; at this point is an outcrop of fine greenish quartzose schist. In the course of the next mile are two small rapids which can be run; the lower however is provided with a portage on the east side. We now come to a series of small rapids extending for two and a half miles in the following way:

Rapids. Run, or portage on the east side.
One quarter mile of open water.
Rapids. Run; a poor portage exists.
One-half mile of open water.
Rapids. Run.
One-half mile of open water.
Long rough rapid with chute at end; portage on west side. Rock, a hornblende microcline granite.
One quarter mile of open water.
Last rapid. Falls; portage of three chains to west.

There is a log jam of a permanent nature provided with a portage on the west, a short distance below the last rapid. From this point one and a half miles in a northeast direction brings us to the mouth of the stream in the Black river, which joins the Abitibi a few chains lower.

Huronian Schists on the Black River.

The Black river near its mouth has a width of three chains, with dirty brown water. Up stream we travelled in a direction a little east of south for 13 miles without interruption. On this stretch there are several exposures of fine Huronian schists and diorites with pyrite. Two considerable creeks enter as shown on the map, but are not at all navigable. Sandy clay soil predominates, clothed with the characteristic spruce and poplar. A large, recently burnt tract, with trees still standing, is cut by the river for six miles, but terminates before the first rapid is reached. The river at this point falls 12 feet over a dike of massive diorite striking northwest. A good portage of two chains affords a means of passing on the east side. A mile farther up is a small rapid over a ridge of diorite schist striking N. 35 W. The fall is only about six inches. Five chains above this ripple is an exposure of fine gray to black schist with pyrite interstratified with diorite, the whole showing rhomboidal jointing. Ten chains above this exposure another rapid occurs with a portage of five chains on the

eastern side. The hill here rises t
of 30 feet and presents exposures
and diorites at both ends of the ra
its central part is occupied by a bos
blende granite. On the opposite si
river is an outcrop of a dark r
round white spots of one-quarter i
eter, exhibiting fluidal structure
magma. It is probably an amygd
the specimen brought is too much a
exact determination. Here also
rock which is probably a mucl
porphyry.

Beyond this point rapids beco
numerous, there being three in the
miles. The first two require no po
the last is a fall of eight feet over d
is passed by an eight-chain porta
east side. About two miles more
to a fall of 15 feet, with a portag
chains on the west side. The wat
forced through a narrow gorge, in
rocks splashed with quartz and a
with diorite belts. The land run
elevation of 50 feet on both sides,
at the top; inland, however, it
into muskeg.

After passing the falls the rive
almost continuous rapids and I di
sider it advisable to follow it far
dians however go through this w
head waters of the Rivière Bla
thence to lake Temiscaming. I w
formed that a portage leaves this ri
where near the first falls and conne
route to the Matachewan waters.

Among the small rapids at the h
stream were found exposures of p
with three inch inclusions, also da
with diorite and splashes of quartz,
with a little hydromica.

While camped on this river on
heavy thunder storm following a
raised the water two feet in one n
S. Ritchie, who had camped the s
on the small island below Iroquo
the Abitibi, found his canoes was
in the morning, although they we
above the water line at night.

An expedition east from the hig
reached on the river revealed the
of a hill of diorite fully 100 feet h

soil prevails beyond the summit, the country gradually falling. No muskeg was encountered in a trip of two miles. The timber is fair, but has been much destroyed by hurricanes.

West from the same point there is a hill of 50 feet, sinking rapidly into muskeg and alternating with clay flat.

Abitibi River.

The River below the Big Bend.

The Black river enters the Abitibi at a point where the latter turns abruptly to the north with a width of three chains. I encountered considerable current from the junction to the Two Portages, a distance of five miles upstream in a northeast direction. Here are two hard rapids 100 yards apart with portages of three chains, both on the east side. The lower fall is in three lateral cascades over a weathered diabase with pyrite, the descent being about nine and a half feet. The upper over the same rock falls only six feet. Glacial striae are well marked at this point with a direction N. 15° E.

Iroquois Falls.

From the Two Portages to Iroquois falls, a distance of ten miles, only one exposure of dark schist is observable. The banks of clay soil are uniformly well wooded throughout this stretch. Iroquois falls is the most important vertical drop on the river. The difference in level between the two ends of the portage is 25 feet, but the actual falls is somewhat less. The plunge takes place over a barrier of dark gray weathered diabase 10 chains long, running in a direction about north and south. It is broken into three lateral cascades by two small islands; while a third directly below the falls affords an excellent point of view for a very impressive scene.

Duck Deer Rapids and the Laurentian Contact.

For six miles the river continues between clay banks with a fair current, when it is again interrupted by a constriction of red gneissoid granite causing the speed to increase. Two miles farther we enter the Duck Deer rapids of 30 chains, over hornblende gneiss. This water can readily be run in fair sized canoes, but two portages of three chains each on the easterly side show evidence of considerable use. It is apparent that the Laurentian contact occurs between the Iroquois falls and the first granite outcrop observed. As no exact information is obtainable I have placed the line of contact on the map half way between the two points.

Below Duck Deer rapids the river widens, in places to 20 chains, and several small islands occur, while affluent creeks of small size are numerous.

Cross-section Lines of Exploration.

Rolling Clay Land and Swamp alternate.

Twelve miles below the rapids an expedition was made to the line, a distance of 11 miles. The first two miles traversed dry rolling clay land; the ordinary river bank territory. This is followed by two miles of low swampy country, passing into muskeg, but rising into another ridge of one-half mile of dry soil. Beyond is a swamp which continues to the line, interrupted by a third ridge of top land with poplar and spruce. As the boundary line itself traverses much the same type of country, it may be concluded that this region is composed of low wet tracts, interrupted in places by ridges of higher land running approximately north and south. Two miles south of this cross-section another was made for a distance of five miles with the following results:

One-half mile of river bank, with poplar and spruce.

Three miles of wet clay-bottom land, timbered with spruce.

One and a-half miles of very level wet swampy land.

Opposite these two trails two others were made east of the river. Both of these seemed to indicate, for a distance of three miles, the presence of a somewhat higher country, well timbered with large spruce and poplar, but affected in places by windfall and fire.

Six miles farther down the river a small rapid occurs, easily run in any canoe. The bed of the river seems to be composed of Laurentian boulders, but no rock was seen in situ. Trips were made east and west from this point; that to the east showed low clay shores with the usual poplar, then a mile of low swampy scrub spruce land, followed by an area of clay rising to a height of 100 feet. For a distance of some miles the country maintains this elevation, but it is rendered almost impassable by severe and extensive windfalls. Among the fallen trees were

Below the Three Carrying Places the river widens and contains many islands, while the current is stiff. Two miles down it narrows to a chain and a half, presenting a heavy current but quite smooth. Again it widens and has 10 or 15 islands for three miles, when a constriction and heavy rapids occur. This fall is in two sections : the upper part can be run by keeping the west shore and running into the bay beyond. However a short portage is provided on the west side. The lower rapid is much heavier and is broken by an island. Nearly all the water follows the the eastern channel ; in fact in low water all of it. In high water the bay to the west referred to above would not exist, and it might then be more difficult to cross to the Island portage, which is on the island and is about two chains long.

At both these rapids the rock is gneiss, but just where the portage crosses the island is a peculiar lens-shaped inclusion, ten feet wide at the north end, but pointing out on the south shore. It apparently dips 45° westwardly. The inclusion is in places quartzoze, in others highly altered, with much pyrite and magnetite. Under the microscope the rock shows augite as the prominent constituent, with a little quartz and plagioclase. The quantity of these is so trifling that the rock may be regarded as a pyroxenite. In the vicinity of this outcrop the gneiss itself is highly garnetiferous.

For the next 12 miles the river has a fair current and is bordered with clay and sand bluffs, the latter increasing in importance northward. These shore banks are, for the most part, clothed with young poplar. At the end of this 12 miles a considerable creek, known as Red Sucker, enters from the west. This stream was ascended two miles, in which distance three rapids were met. Beyond for two miles it is a continuous rapid over gneiss. The shores on both sides rise to the height of 100 feet and are composed of fine sand at the top and coarser materials below. Some pitch pine is found on the top of this ridge. A trip west from the foot of the long rapid, after passing the elevation, brings us to a long level spruce tract. Two small lakes were encountered, which, differing from the swampy lakes previously seen, present shores of fine sand and shingle. From this fact and from the drier nature of the spruce flat it may be concluded that the whole of this region possesses sandy soil.

Red Sucker Creek.

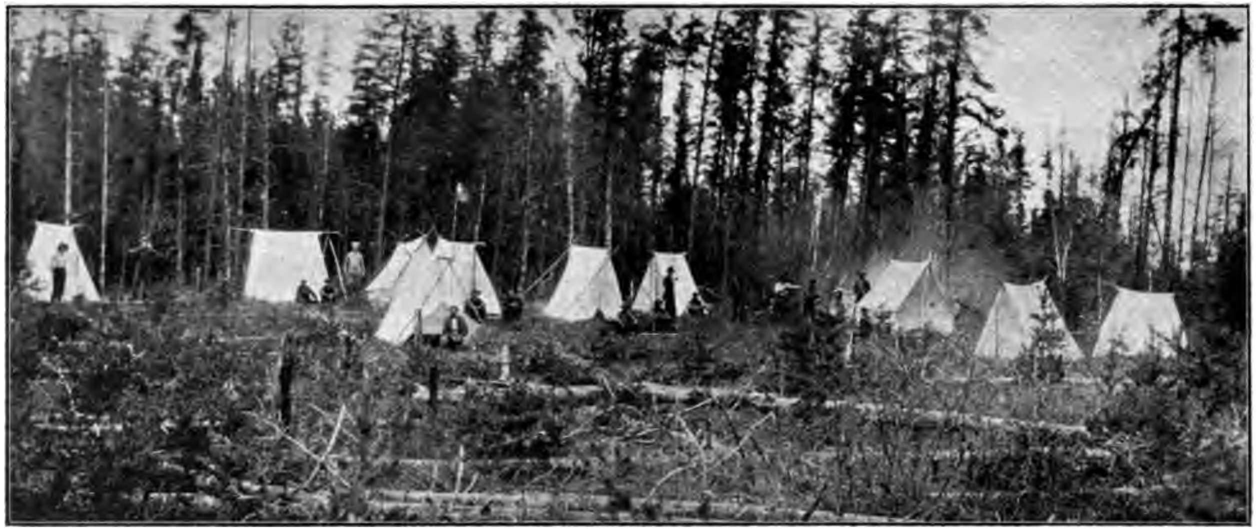
Three and a half miles below Red Sucker creek the river turns to the west with increased speed. One and a half miles lower it plunges down a declivity, necessitating the Lobstick portage of a half mile on the east side. An interesting series of rocks is shown here. On a small island above the rapids are seen tender mica schists striking northwest and southeast and dipping 20° N. This is followed by a dark, highly garnetiferous rock, which appears to be an altered augite-syenite. At the brink of the fall the rock is a distinct augite-syenite. On the east side, at the portage, we have a dark fine-grained rock of a schistose nature, followed by what appears to be a quartz porphyry. This is replaced by a typical augite-syenite with pyrite. Below the rapids is gneissoid mica schist, very rough and with pronounced jointing. The conclusions are, therefore, that a barrier of augite-syenite crosses the river east and west, inducing certain modifications in the gneiss and being itself rendered schistose at its borders.

Lobstick Portage.

Below the Lobstick portage the river must be crossed in dangerous water to the Burntwood portage on the opposite side, which passes by a trail of 300 yards a very bad piece of rapids. A mile of fair water succeeds and different routes seem to be followed beyond, some portaging on the east and some on the west side. A high clay hill gives the name of Clay falls to this rapid, and there is a portage along the face of the cliff on the east side of the river, and another but little used a short distance beyond. The river at this point is wide and filled with islands. The hill at the Clay falls referred to above shows in ascending order—

20 feet fine sand interstratified with a coarser part and gravel.
One foot of stratified clay.
20 feet of stiff boulder clay with limestone erratics.
20 feet of fine stratified sand.
10 feet of stratified clay.

A half mile lower is a level easy portage known as the Birch portage, on the east side

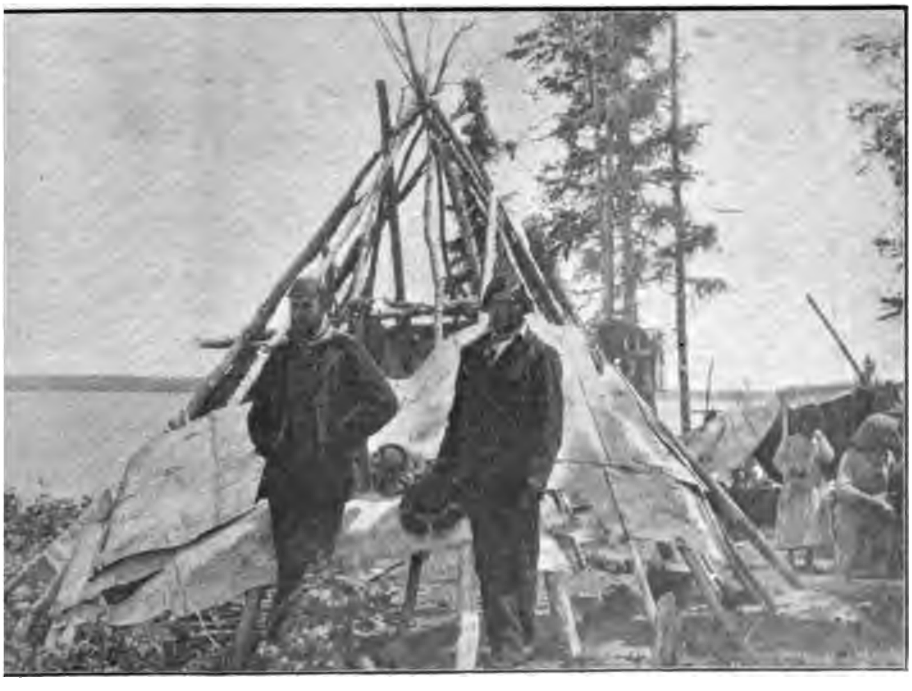


13 Camp near Night Hawk River. Sand Area, with Pitch Pine. —Parks

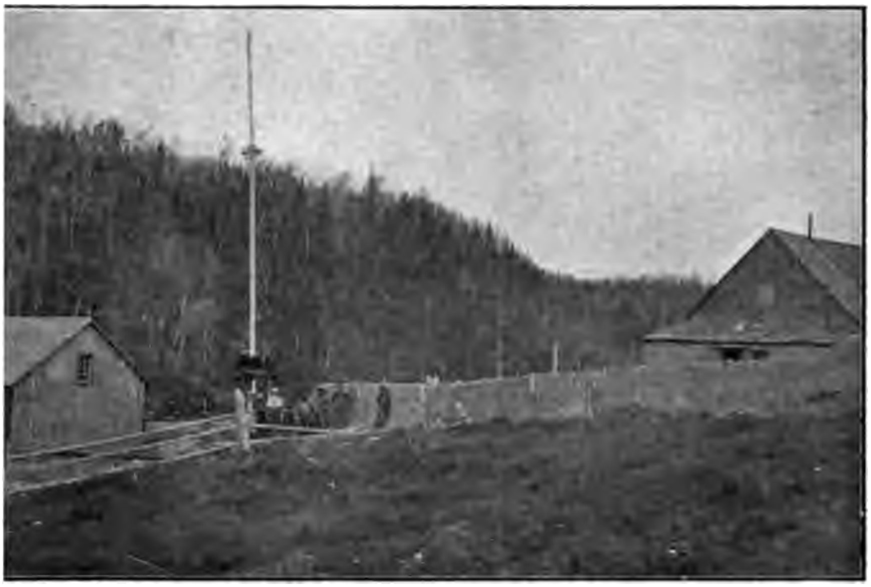
Surveyor Niven's Party at Luncheon, on Montreal River. --Parks.

H. B. Co. Factor and Family at Fort Matachewan, Montreal River. --Parks.

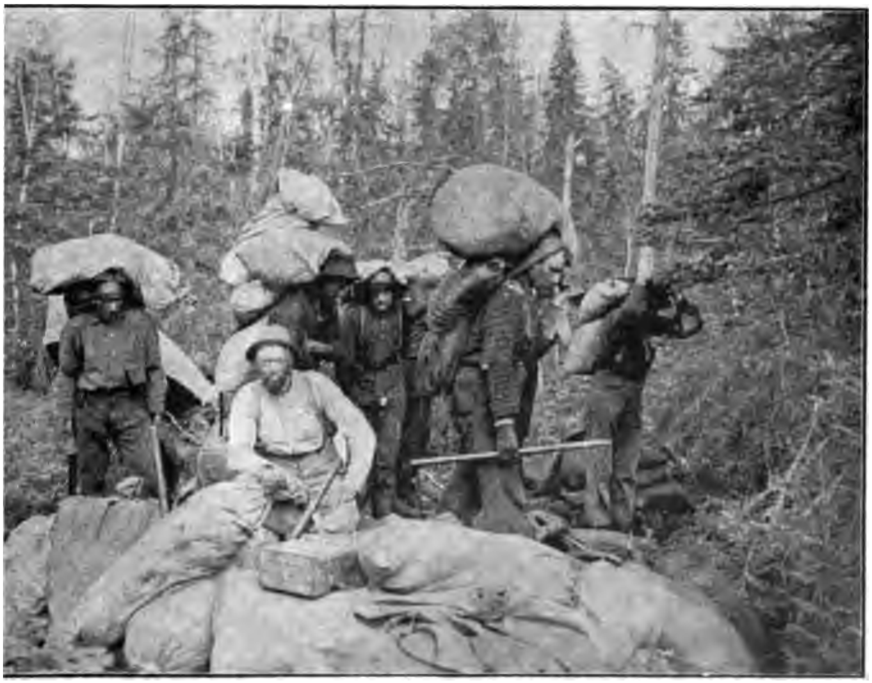
High Water Scene on Night Hawk Lake. Parks.



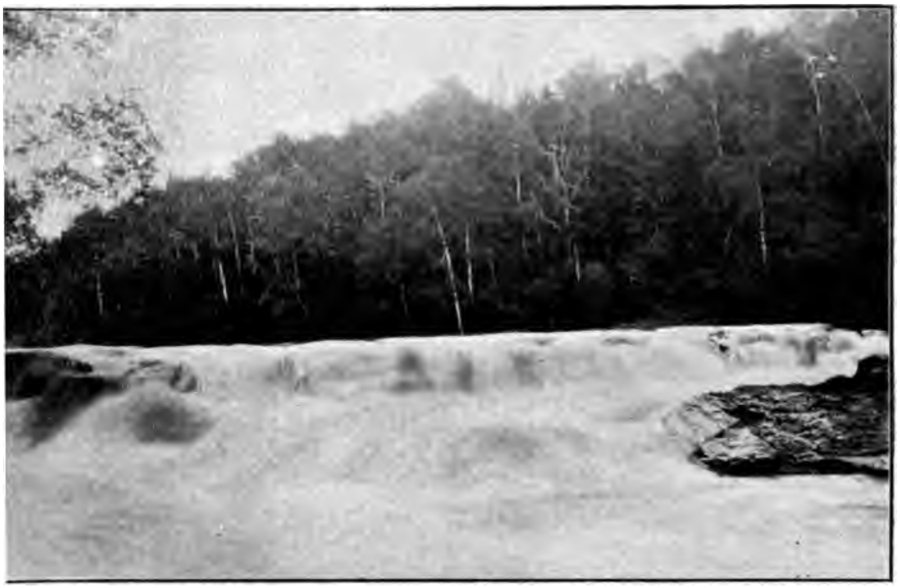
Bernard McLeod, Trader, and Chief Buffalo, at Night Hawk Lake Parks.



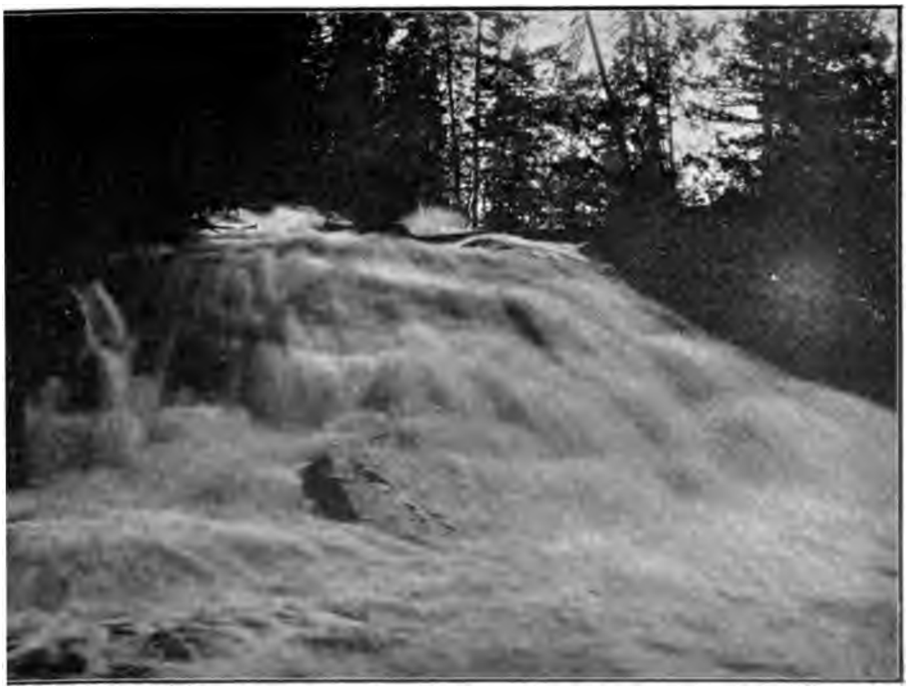
Fort Matachewan, H. B. Co. —Parks.



Packing Supplies over Height of Land, Montreal River to Night Hawk River. —Parks.



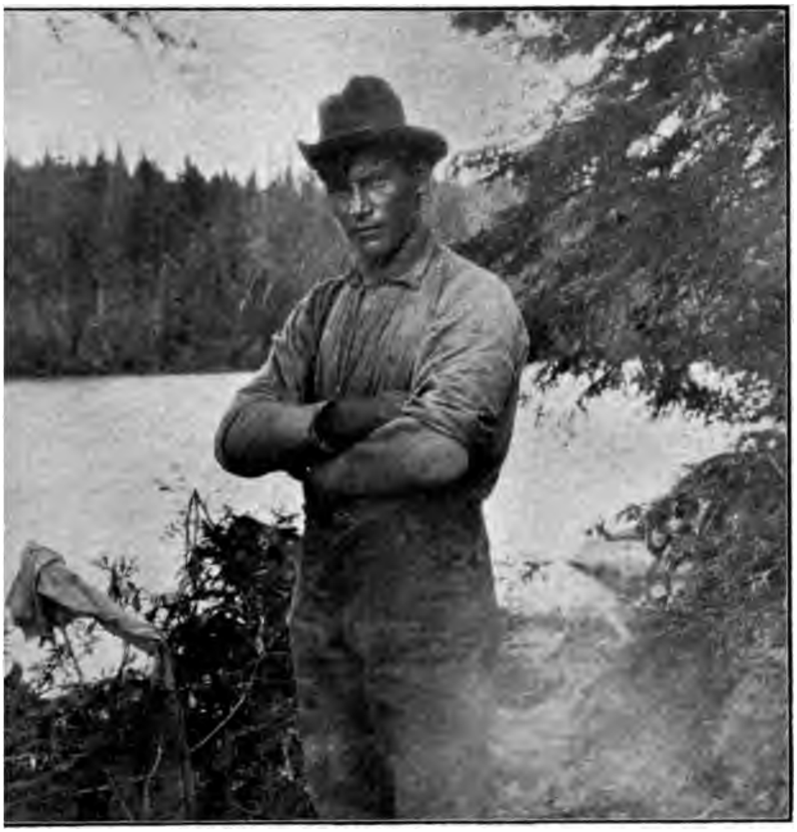
First Falls, Upper Western Cascade, Frederick House River. **--Parks.**



First Falls, Lower Middle Cascade, Frederick House River. - Parks.

Below the last of the Three Portages, Frederick House River. - Parks.

Iroquois Falls, Western Cascade, on Abitibi River. Parks



Indian Packer at the Long Sault, Abitibi River — Parks.

Running the Long Sault, Abitibi River. — Parks.

Supplies at the Long Sault, Abitibi River. —Parks.

Below Island Portage on Abitibi River. —Parks.

here the river narrows to a chain
ith great violence. A short dis-
nce lower is the Oil Can portage,
hich enables the traveller to pass
strong fall. Both these portages
th of 300 yards. At the foot of Oil
the rock is augite-syenite or gab-
contains both species of felspar
t to decide, but it is probably the
he outcrop at the Lobstick is evi-
variety. This rock strikes N. 30°
a gray appearance, but the fresh
ows a distinct syenitic structure.
s of calcite and bands of a dark
l material traverse it in all direc-
ove the Oil Can the rock is much
h a highly syenitic appearance.
bend to the west 20 chains above
small quantities of a much altered
sphene and mellilite occur. Here
tinct veins of a hard black schist
west, but not persistent in strike.
Birch portage the rock is highly
and at the place where the river
tains veinlets of crushed granite
all directions and presenting beau-
les of dislocation on a small scale.
ll canoes and especially when
the river it is found advisable to
her route in passing this series of
he head of this trail leaves the
here it turns west and the current
out a mile and a half above the
ortage. The first portage is one
miles long in a direction a little
rth ; it is quite level over sandy
osses two creeks. This ends in a
we cross nearly due north 25
he next portage is only 100 yards,
th of west to a lake of 13 chains.
l portage west of north over fine
ects this lake with the next, a
ond. Then succeeds a 700-yard
est of north followed by another
ake. A 100-yard trail over fine
us to the last lake. From here a
to the bay below the Oil Can
It traverses sandy soil and rises to
b e height, falling suddenly as it
the river. Aneroid readings gave
the hill as 120 feet above the foot
of the Oil Can portage and the last lake 104 feet above the same point.

Canon of the Abitibi and the Otters.

Rocks of the Great Gorge.

We next cross a bay of a few chains on the east side of the river to a portage of two miles, leading past the canon of the Abitibi. This gorge has a height of 100 feet with precipitous walls, while immediately inland the country rises to an elevation recorded by aneroid of 200 feet. In this chasm the river is narrowed to about a chain or less and rushes with great violence throughout, causing a deafening roar in the confined space. The upper end of the canon presents rocks of the same nature as those described at the portages above. One half mile down occur segregations of anorthosite, and at a mile the rock is a weathered gabbro with stringers of crushed granite containing pyrite. The rocks here reach the greatest height on the gorge and are much mixed, with blebs and strings of associated materials. As we near the foot of the gorge we meet with large masses of crushed granite sheared north and south. As gneiss was seen a short distance below the canon we may conclude that the contact is very near the end of the rapid. Thus we have a belt of eruptive crossing the river a little north of west. Its southern part seems to be more acid, being represented by augite-syenite at the Lobstick portage. To the north it is more basic, passing into gabbro at the canon. Throughout the belt shows evidence of having been much contorted and broken by secondary minor eruptions.

Twenty chains below the canon the river is shallow and swift, presenting a rapid a quarter of a mile in length, but easily run. Expeditions east and west were made a short distance below this ripple. That to the east showed a bank of fine sand over a hundred feet in height, clothed with scrub poplar and birch, evidently an old brulé. This is cut by numerous small streams which have dug out deep valleys of denudation. Without much descent this gives place two miles inland to the usual succession of clay flat and muskeg. At an elevation of 75 feet occurs an outcrop of gray mica gneiss to the east of the river. The soil is sand, intersected by creek valleys.

One mile in, hornblendic gneiss is seen on a creek. Large poplar and spruce cover the whole district. From this point to New Post, a distance of six or seven miles, there is an occasional outcrop of gneiss, while sand banks are continuous for the stretch, showing terraces at 20 and 100 feet. New Post is the only trading station of the Hudson's Bay Co. on the Abitibi, and is the only place where supplies of any kind can be obtained between Fort Abitibi and Moose Factory. Mr. Jobson, the factor in charge, has a flourishing garden in which are turnips, onions, potatoes, corn, cabbage, lettuce and radishes, all doing well. Early Rose potatoes were rotting in the ground, but white late varieties do well; 300 bushels were grown last year. Corn will ripen some years, but it fails on other occasions. Mr. Jobson has several head of cattle, the winter fodder for which is gathered by the Indians, and consists of the marsh grass abundant along the river. The soil is fine sand, argillaceous in places. As an example of the vagaries of the river, Mr. Jobson informed me that in the spring of 1897 the water rose to the foundation of his house, a distance of 29 feet. The Indians attached to this post are rapidly succumbing to the attacks of consumption and scrofulous diseases, and owing to the decrease of partridge and rabbit are sometimes at sore straits for food. As the rabbit fails the lynx also disappears for want of prey, while the beaver is almost hunted out in this district.

New Post Trading Station.

Little Abitibi River.

Half a mile below New Post a stream enters from the east. About two miles up this creek brings us to a very beautiful fall where the water drops 90 feet, almost vertically over gneiss. A portage from New Post 50 chains in length connects with this stream above the falls. In high water only can this river be ascended, as it is very swift and shallow. By dint of great exertion it was ascended 20 miles in a southeast direction. From here a portage of one and a half miles, broken by a little lake, leads into the Little Abitibi river. This latter stream was found to be a succession of rapids, but was descended 10 miles and a trail made from there

An excursion to the Little Abitibi.

to the line, a distance of 12 mile
usual poplar and birch were encoun
the shore of the little river, sinking
muskeg with scrub tamarac and
which continues unaltered to the line
creeks and several small swampy lal
met with, and the line intersecte
miles and 40 chains.

From New Post to the Otters the
is fairly heavy, but smooth. The b
sandy and high, with gravel beaches
races, a feature never seen on the up
of the river where the vegetation re
the water line. The timber on thi
(14 miles) is small poplar and spruc
little pitchpine.

The rapids at the Otters are extrem
and picturesque, the river being fo
tween narrow banks and
considerable descent. Th
red gneiss and bands of dark sch
pyrite. The portage is on the east
is a wide open trail, with corduroy, e
constructed by the H. B. Co. for th
port of large boats. The soil is sa
with gravel. The trail is crossed
creek valleys, and there are two s
scents at the north end. The porta
miles long, but it may be shortened
mile by taking the river for that di
the middle. The trail does not s
this is often done however.

Rapids at the Otters.

A Region of Devonian Rocks.

Below the portage is a barrier of
requiring care to pass. A mile far
two small islands and swift
passing into rapids. Th
portage of 20 chains on
side which does not appe
much used. I found it necessary
small canoe to portage part of the l
this point outcrops the lowest memb
stratified deposits, being represent
coarse red sandstone conglomerate.
chains lower on the west side is 20 fe
same deposit, interstatified above an
with a dark shale dipping west and a
feet thick. This is succeeded by te
soft felspathic sandstone, with a hi
careous matrix and with crystals of
the cavities. The whole is cover
strong stony clay. Many landslip

Sandstone-Conglomerate and Shale.

ace of the cliff, and blocks of other rocks een in situ are revealed at the foot of ı slips. A little higher up the river, site the last described rapid, the sand- ı is covered by 15 feet of hard gray clay, boulders roughly stratified at the bot- but not so apparent above. This is red with sand and gravel. Almost im- ately inland we pass into muskeg.

ıe next rapid, the Sextant, is almost a nuation of the last; it is broad and ow, a character shown by almost any rapid from here to the sea. This is of course on account of the difference between the stratified de- s and the harder Laurentian rocks. On west shore at the Sextant a peculiar . of dark shale runs from the water's up to a height of 20 feet. It contains 'emains of several species of algæ. The ant portage is one-quarter mile long ›n east side. At its foot the red ferrugin- andstone occurs covered by shaly dolo- ; limestone to a height of 50 feet; these stones are arenaceous in places, and con- fossils of Ambonychia, Orthis and Modio- ıs. As nearly as I could determine there dip northwest of 23 feet in 60 chains.

itic
tone.

ıe and a-half miles down is another i of the same character as the Sextant, . a half mile portage on the east side. river drops six or seven feet, but the age rises to a considerable height over soil. The rock here is a thick bedded stone with numerous fossils, for exam-

Favosites polymorpha.
Favosites turbinata.
Favosites hemisphærica.
Heliophyllum Halli (?).
Zaphrentis gigantea.
Zaphrentis prolifica.
Eridiophyllum.
Cyathophyllum.
Crinoid columns.

elow this rapid the river maintains a heasterly direction, is swift and shallow not at all dangerous. Its banks are low for the most part, with clay and roughly bedded gravels. Six miles down we enter the Pudding rapid. river here is 400 yards wide and cor- ondingly shallow. I believe the route for large canoes lies along the east shore, but I proceeded down the west side, running part and wading through others. A mile or two of this brings us to a large island, showing thin-bedded limestones, and at its northern end a dark soft shale with fucoids apparently dipping north. Beyond this island is two miles of swift but easily canoeable water, filled with islands. The lower part much resembles the upper, and has a large island in much the same relative position. This island is bent into sharp anticlines and synclines, rendering it impossible to ascertain the strike or dip. Below the island the swift water continues, and the river is finally thrown with some violence against the west shore by a point from the east side. This is a well marked spot and constitutes the end of the Pudding; the water is not too rough for large canoes. With small boats it is safer to track on the east around the point.

ing
L

Plum-pudding island lies a mile below the rapids; it presents clay shores much torn by river ice. Three miles more of somewhat shallow water with stiff current brings us to the Little Abitibi river on the east side. At its mouth this stream is 100 yards in width and a foot deep. Its water is brown, and its shores low, with young poplar. A description of the succession of rapids on this stream would be tedious; with the exception of a few short stretches it is all rapids as far as it was ascended, a distance of 30 miles. The more important of these are marked on the map. This distance cost nearly three days hard work to ascend, but, thanks to some heavy rains, we were enabled to run the whole way down in six hours. Limestone exposures occur on the lower reaches, a very fine one three miles up. This rock strikes N. 10° E. and rises into an anticline at the rapids. Fossils:

Little
Abitibi
River.

Fossils
of the
Limestone

Rhynchonella sp.
Pentamerus sp.
Renslaeria ovata; very numerous.
Dentalium sp.
Zaphrentis prolifica.
Alveolites sp.
Monticulipora sp.
Michelinea convexa.
Holopea?
Orthoceras sp.
Gomphoceras sp.

These are evidently different beds from those described on the Abitibi at the rapids below the Sextant. There the fauna is strongly corraline, while here it is more mixed, the brachiopoda being the most prominent group.

A Laurentian Island in the Devonian Sea.

About a mile above this outcrop an exposure of gneiss occurs on the river, forming a strong rapid and rising into burnt hills on the east. The contact here is beautifully shown, with corals growing on the ancient gneiss sea-floor. This gneiss exhibits a vertical dip, and is laminated northeast and southwest. The next rapid above is also over Laurentian rock, beyond which no outcrop occurs in many miles, when Devonian strata again appear with

Atrypa reticularis.
Cyathophyllum sp.
Michelinea convexa.
Several species of Orthoceras and numerous small gasteropods and lamellibranchs.

It is therefore apparent that the gneiss outcrop must represent a Laurentian island in the Devonian sea, or an elevation of the gneiss from which the Devonian rocks have been denuded. At the end of the trip, 30 miles up, there is an apparent outcrop of gneiss which probably represents the contact. The rapids above are very hard and the river beyond is a constant succession of rapids to a large lake, the Little Abitibi, said to lie some distance to the southeast. The line crosses the river at the 212th post. Near this point gulls and flying loons were heard, so it is probable that the lake is not far distant from the crossing point of the line. A portage leads from the Long Sault rapids to the Little Abitibi river, whence the ascent is made to the lake. Along this stream high banks of clay and sand occur in many places.

To the west of the contact the hill rises 75 feet, and is composed of boulder clay at the bottom and gravel and sand at the top. Inland is a level sand area with pitch pine for 10 chains. Beyond this the country consists of muskeg with spruce and tamarac. This was traversed for three miles and found to become gradually wetter westward. To the east there is 30 feet of a clay hill followed by 15 chains of six-inch spruce on dry soil. Wet muskeg succeeds, crossed by a ridge of dry land not far from the river.

The Little Abitibi may be said to occupy a valley of denudation in a very level tract of territory, having boulder clay at the bed rock and sand, gravel or stratified clay at the surface.

Below the mouth of the Little Abitibi the Abitibi is 200 yards wide with low shores. Three miles down is Barebone island with 100 yards of river on each side. This island is 20 chains long with stratified clay overlaid by sand. The clay is peaty, but a washing of it gave no indication of its having other than a recent origin.

Lignite in Clay.

A deposit of Lignite in Boulder Clay.

Two miles below the island is swift and shallow water which continues to the Blacksmith rapids another two miles. The west shore here was carefully examined for a mile above and below the rapids in order to locate the deposit of lignite reported by Dr. Bell and Mr. Ogilvie. There is absolutely no exposure of shale or limestone above the water line. Lignite was found however in boulder clay, which was itself black with carbonaceous matter. The deposit was traced about 20 chains down the river. At the foot of the Blacksmith rapids on the east shore it outcrops a little above the water line and presents a more compact appearance and a roughly bedded aspect, striking E. 10° S. and dipping by 15° N. From the fact that it occurs in boulder clay, and also because the dip and strike are quickly variable, I conclude that no inference can be drawn from these features. The deposit on the west shore bears 40 chains southwest from this outcrop. Seven miles down, on Little Cedar creek, and a mile up that stream, were found isolated pieces of the same lignite. These could not arrive there by glacial movement from the Blacksmith rapids, nor could river ice carry them that far up the small stream. It is therefore safe to conclude that deposits of the same nature occur in that region also. It is seen under the same conditions over 100 miles west, on the Missanabie river. The largest block found was two feet long by ten inches wide and thirteen inches thick. The woody nature is quite apparent, but it is sufficiently altered to break readily across the grain. In the beds examined the separate trees were always apparent; in no case was consolidation observed. In the camp fire it was consumed by the aid of wood, emitting a disagreeably pungent odor. Analysis of a dry specimen gave—

Moisture, 8.016 p.c.
Volatile matter, 38.63.
Fixed carbon, 50.408.
Ash, 2,945.
Heating power, 6995 calories.

The occurrence in boulder clay would not indicate a local origin in the deposit; the carbonaceous nature of the clay itself points to considerable friction of transportation. These considerations lead us to conclude that the material will never prove of much value, but a more extensive examination is necessary in order to establish its ultimate importance. A few men with shovels and picks would be able in a few days to disclose enough of the lignite to settle the question of its value.

From two miles above the Blacksmith rapids trips were made inland with the following results:

East. Rise of 20 feet, sand hill with spruce and poplar. Creek north, 20 chains clay flat. Very wet muskeg.

West. Rise of 30 feet, 50 chains of level spruce and poplar land; 60 chains of dry spruce country to a stream flowing north, the Onakawana river.

The River below the Lignite Deposit.

Big Cedar Creek and Onakawana River.

The Blacksmith rapid probably takes its name from these deposits of lignite; it is shallow and 300 yards wide, with the deepest water to the east. It can easily be run. One and a half miles below the rapid a stream enters from the east, known as Big Cedar creek. At the time of my observations no canoe could enter it, although it may be navigable in high water. It is a stream of some length, as it extends still with considerable size south of the latitude of New Post. Two shallow rapids of no importance intervene between this stream and the Onakawana on the west side, three miles down. This river is very shoal, and 60 yards wide at the mouth. Rapids are almost continuous. Its immediate entry is from the northwest, but it soon turns south and runs not far distant from the Aitibi. It occupies a valley of denudation in boulder clay and does not reach bed rock as far up as observed. The rapids occur over boulders of gneiss and limestone which are more numerous where the banks are high as might be expected. A little poplar is seen on the shores, but the muskeg begins immediately inland.

To the southeast, opposite the Onakawana, there are two belts of high poplar land, followed by muskeg of spruce and tamarac with a heavy undergrowth of alder.

On the main river two miles of smooth water is followed by swift and shallow rapids to the mouth of Little Cedar creek on the east side. A careful study of the surface geology was made at this point. There is 12 feet of level stratified clay at the river's mouth; three chains up this clay rises to a height of 15 feet and is underlaid by a hard stratified clay of a totally different aspect for four feet; this in turn, is underlaid by four feet of stratified sand and gravel. Below all is eight feet of boulder clay. Ten chains up boulder clay rises to the top of the hill; 20 chains up coarse gravel occurs over boulder clay at a height of eight feet. One half mile up we have 25 feet of stratified clay overlaid by two feet of boulder clay, in the top of which are found shells identical with species now living in James Bay. For example:

Tellina Greenlandica.
Maconea fragilis.
Maconea calcarea.
Saxicava rugosa.
Mya sp.
Several gasteropods and a species of Pecten.

Five chains above this are 25 feet of stratified clay, and 20 chains beyond boulder clay rises to the same elevation. The fossiliferous clay is black like the lignitic clay, and is overlaid by coarse gravel with cardium, gasteropods, etc. Across the Abitibi are 15 feet of stratified clay, apparently alluvial. At higher elevations is found a hard chalky stratified clay. It is therefore apparent that the rock is covered by boulder clay, which is overlaid irregularly by stratified deposits of recent date. In addition to these there is a belt of varying width following the river, consisting of alluvial deposits of still later origin.

An expedition was made overland, a distance of 12 miles to the line and five miles

An Exposure of Gypsum.

beyond to the French river. Between the river and the line nothing was seen but flat wet muskeg and 12 small creeks flowing north. This trail crosses the line at the 275th post, in the middle of an exposure of gypsum having a diameter of three miles in all directions. The same muskmeg country continues to the French river, but is even wetter and is dotted with several ponds.

Enormous area of Sphagnum Moss.

For five or six miles below Little Cedar creek the river continues swift and shallow, with numerous small rapids showing ridges running about east and west. A trip east from here revealed a river bank only ten feet high, followed by half a mile of level land with eight-inch spruce ; this passes into continuous wet muskeg with small red spruce. At various points in this muskeg I endeavored to ascertain the depth of the moss, but could not penetrate beyond a depth of three or four feet owing to lack of appliances and to flooding by water. At that depth the moss was quite perfect, no sign of decay being apparent ; fragments of birch and small twigs of spruce were also well preserved. The moss is chiefly sphagnum, and as it extends over an enormous area, with unknown depth, it is safe to conclude that we have here an immense reserve supply of fuel in the form of peat. Regarding the extent of this supply it may be said that the deposits in question cover the whole region for 100 miles around the south and southwest sides of Hudson Bay. The line for the last 100 miles traversed an almost continuous tract of this kind.

The scenery through these immense stretches is unutterably dreary and monotonous ; the whole region is perfectly level, without the slightest elevation to relieve the eye. Travel through such a country is of course very arduous, owing to the continual exposure to wet and to the immense swarms of mosquitoes and black flies engendered by the large stretches of swampy land.

The spruce over these muskegs does not average six inches in diameter, and can be of little use even for pulp wood. I do not wish to convey the idea that no spruce of value occurs in this northern region ; as before stated, larger trees are found along all the rivers and lakes.

The Abitibi re-crossed by the Line.

From the mouth of Little Cedar creek it is 25 miles in a northeast direction to the mouth of the Abitibi. The river has numerous islands and several rapids, all of which can be run down and poled up. The line crosses half way down this stretch, at the 288th post. For purposes of navigation the following list may be found useful :

One mile, island of 25 chains.

Four miles, several 20 chain islands.

One and a half miles, shallow rapids and islands.

One mile, 30 chains of bad shallow rapids.

Two miles, pass three small islands.

Two miles, island, hard rapid, channel east side of west branch.

Four miles, shallow and swift, not rough.

Two miles, several islands and some shallow water.

Four miles, three large islands.

Three miles, islands and swifter water where the river widens and passes into the Moose through several mouths.

At the end the rapids become heavy. It is advisable to run down the west shore as far as possible and make a portage past the worst part. The portage is about ten chains long and avoids a very bad swell. Care is required below the portage, as there is still rapid and shallow water. The rock here is a thick bedded non-fossiliferous dolomitic limestone, 12 feet in thickness.

Moose River and James Bay.

Courses and Rapids of the River.

The Moose river at the mouth of the Abitibi is over a mile wide, is shallow and fairly swift. A clear sight N. 40° E. (mag.) bears on a green point on the south side. In this distance are two long shallow rapids which can be best passed by crossing to the north side of the Moose as soon as possible after leaving the Abitibi. This manoeuvre also enables the traveller to avoid a long bar stretching into the river from the above mentioned point on the south side. From here the course lies 66° E. of N. for six miles to a point on the north side. In this stretch are two small rapids. A mile below the point, at a bearing of 80°, is the last rapids and the head of tide-water. Throughout this distance the north side is preferable, both for the reason already given and from the fact that the clearer waters of the Mattagami and Missanabie keep to that side and do not mix with the muddy water of the Abitibi to the south. Below the last rapid it is seven or eight miles to Moose Factory. A chain of islands occupies the middle of the river, which widens to two or three miles. Moose Factory is on the south side of Moose island; the traveller should keep along the north side of the islands un il seven miles down and then turn south between them. All along the Moose river and on the islands appear deposits of boulder clay or of strong stratified clay. Inland the country is very flat and shows the characteristic muskeg. With gradually increasing width the river continues 12 miles below the Factory and enters James bay. It is impossible for a ship of any size to approach nearer than this to the Factory. The Company's vessel, the Lady Head, anchors at this point and discharges her cargo into lighters which are towed by a small tug to near the port, where a second transhipment into small barges is necessary in order to effect a landing. Outside the anchorage are bars which require all the skill of the pilot, taking advantage of high water, to pass.

Head of Navigation on the Moose.

Features of James Bay.

James Bay is so shallow that 15 miles of shore is said to extend between high and low water a few miles north of Moose river. That this shallowness is due in part at least to the fact that the whole region is gradually rising may be seen from the following observations:

The Rising Region of James Bay.

1. On Little Cedar creek at a height of 25 feet above the stream, which probably represents 100 feet above tide water, were found shells of animals now living in the bay.

2. Old inhabitants of Moose Factory unite in saying that islands in the bay, which were mere specks within their memory, have obtained considerable size, though seldom, if ever, covered by the water.

3. A marshy island opposite Moose Factory, which is now at least a half mile long, is well out of water at high tide, althou.h covered with water only at the time of the spring freshets. Within the memory of men now living at Moose Factory it did not exist at all.

4. A river of the size of the Moose would have cut a channel some distance inland had not some such secular movement negatived its action.

The shallowness is in part owing to the silt which is borne into the bay by many of the rivers entering it. Whether the bars now existing are constant in position is hard to determine on mere information. In conversation with men at Moose Factory I received the most contradictory information on this point. This is a matter of importance because, if shifting in nature, these bars would require constant dredging in order to keep a channel open. If constant in position I would conclude that the rush of tide and current would tend to keep them open.

Whether a harbor is possible at Moose Factory is a question entirely outside the scope of this report. I give these few facts and must let the reader draw his own conclusions. I am certain however that it could be done only at a great outlay.

Commercial Aspects.

There are no fish of any account in the Abitibi. Whether or not they are numerous in the bay is again a questionable point. I have heard that fish were so scarce that it was difficult at any time to obtain a mess. On the other hand, schools of fish were so compact as to impede the navigation of small craft. The most reliable information seems to point to the scarcity of fish of any commercial value. The fur-bearing animals do not seem to be seriously decreasing. Otter, fisher, marten, fox (red, silver and cross), mink and beaver are still numerous, and the annual yield is about the same as formerly.

Fish and the Fur-bearing Animals.

Moose Factory is over two hundred years old, and has been for some time the main point on James bay. Here are situated the head offices for the region; as the vessel from England lands all supplies here it becomes the centre of distribution for the whole bay. The population is about 200, consisting exclusively of H.B.Co. employés and their families. Several hundred Indians are connected with the post. The company has a small sawmill which manufactures lumber (spruce) for all the posts on the bay. A boat building shop is also maintained, which has turned out vessels capable of crossing the open bay.

Moose Factory.

Missions to the Indians.

Moose Factory also constitutes the headquarters of the Church Missionary Diocese of Moosonee. A substantial church has been erected, as well as a residence for the bishop. Outlying stations have been established at Fort Hope, Fort Albany, York Fort, Rupert's House, etc. The Indians are all, nominally at least, Christians; most of them are able to speak English and to read and write in their own language (Swampy Cree). They use a system of phonetic spelling well adapted to the language. South of New Post the Indians are Ojibways, and adherents of the Roman Catholic church. These Indians do not use the phonetic writing, but can write in the ordinary characters as taught by the Catholic missionaries.

French River.

Drainage system of the River.

On the south shore of the Moose, opposite the last rapid, the French river enters. Its course is a little east of north for the last 32 miles. Above that point it divides into two streams, which again bifurcate and reach more more than 100 miles inland. To the east, by means of tributaries and small lakes, a route leads to lake Sagima, which enters James bay by the Forty Mile river that distance east of the mouth of the Moose. To describe all the rapids and other features of this 32 miles would be very tedious. Suffice it to say that the river is 100 yards wide on an average, expanding in places to a half mile and filled with islands. The current is strong all the way, but no portages are required as all the rapids can be poled. The more important of these are indicated on the map. The shores resemble those of the Abitibi in the same latitude. Many limestone outcrops occur. Some high banks are seen in which are fossils resembling those found on Little Cedar creek. Above the fork the east branch was first ascended. Five miles up it is a large deposit of gypsum, 20 chains long and 12 feet thick. This is the thickness of the exposure, but the whole thickness of the bed is indeterminable. This deposit is mostly gray in color, but pure white granular gypsum also is seen as well as patches of well crystallized selenite.

Gypsum deposit in the East Branch.

Six miles above the junction the stream breaks into two, the Ka-wuk-e-ka-mas-tuk to the east and the Wa-kway-ow-kas-tik to the west. Both were ascended a short distance and found to become more shallow and rapid. The eastern main branch was also ascended six or seven miles and found to be the same as the other two. It is crossed by the line several times, as shown on the map, and is known as the Kah-pah-nay-ow-sis-tik.

Summary of Exploration.

The region covered by this report may be considered as the basin of the Abitibi river, including the district around Frederick House river and Nighthawk lake. A detailed description has been given, and in the following summary will be found a general description under various heads.

Abitibi River.

Characteristics of the River.

The word Abitibi has a somewhat obscure meaning. It is possibly best translated as the river whose waters shine white at a distance; referring to the muddy nature of the water. From the two portages to the Otters, while there are many rapids, the intermediate stretches can be ascended without the use of a pole. Below the Otters, over the limestone area, the river is much more shallow and continually swift. It has already been noted that the general appearance of the upper river is in sharp contrast to the lower portions. This is best seen in the fact that the river is deeper at its margins above, permitting a canoe to approach close to the shore while the vegetation reaches to the water's edge. Below, this is entirely different, as the margins are shallow, forcing a canoe some distance into the river in order to float with safety, while beaches extend all along the limestone region.

Soil and Agriculture.

Areas of Clay, Sand and Muskeg.

Large areas of dry clay soil extend around the Upper Abitibi and in the region of Nighthawk lake, while sandy tracts occupy the districts northwest of Frederick House lake and the height of land between this lake and the Black river. Throughout this section, on passing inland, we come to extensive level tracts, wet in places but underlaid by firm clay soil. If these stretches can be drained in the process of clearing it would open up

ɔr part of the country as far north as
Bend for agricultural purposes. All
ıe river as far as this point the river-
elf, with a width of two miles, is now
tly dry to take the plow. North of
ıd the country is decidedly wetter at
ance from the river, and cannot be
d as other than muskeg. The river
still dry and high, but is not com-
as good soil, being far more sandy
ered with a less luxuriant vegetation.
siderable areas of arable soil exist
ower river. The line itself for the
miles traverses almost continuous
The climate permits the raising of
ıt it is a question if cereals will ripen.
ıas been raised at Moose Factory, but
ring cannot be depended on. For
ıising I think certain parts of the
would prove excellent, as grass
ell and the crop of roots would fur-
d winter fodder.

Timber Resources.

the exception of a few small isolated
pine was seen in the whole district.
Along the rivers and on the shores
of lakes the timber is uniformly
poplar and birch, the rough bark
variety of the former tree increas-
the north. In the wet clay flats
f fair size extends over large areas.
ıber will eventually be of great value
wood. Trees of a large size are not
ıs, the average being about ten inches.
muskegs very small and useless red
predominates, extending over hun-
square miles in the northern part.
dar is seen, but not enough to warrant
ıent industry. Alder, hazel and sev-
ies of willow are the characteristic

Mineral Resources.

ıting on the rivers no outcrops of
seen in the whole region, so well is
the country covered with soil.
Where observed the rock is barren;
o substances of economical value
en—the previously described lignite
deposits of gypsum. At the head
f the Black river rather better look-
s were seen; I understand that some
finds of gold and copper have been reported on the Rivière Blanche. It may be that prospecting in this region might be rewarded.

Water Powers.

Locations on the Abitibi and Frederick House Rivers.

The volume of water in the Abitibi, while subjected to enormous variations, is always sufficiently great to develop power at several places. On this river at the Iroquois falls is an ideal location, with a vertical drop of 24 feet. Another excellent place is the first falls on the Frederick House river, where we have a 46-foot descent in the distance of two chains. Where vertical falls are not the rule on these rivers, we have sufficient descent within a few chains at the Oil Can portage, the Lobstick portage, the Three Carrying Places, and possibly the Sextant.

Fur and Game.

Duck, Partridge, Moose and the Fur-bearing Animals.

Small game, as partridge and rabbit, are not numerous. Duck are said to be plentiful on Nighthawk lake in the spring, but they are very wild in autumn. Very few are seen on the lakes and rivers farther north, but the Indians report them to be numerous on the bay, although very shy and hard to obtain. In the southern parts of the district moose are coming in from the west; red deer are almost absent, while caribou are rare. The small swampy lakes which abound in the level clay areas have at one time swarmed with beaver, which, though still plentiful, have suffered considerably from the improvidence of the hunters. As a whole the region may be considered a fair producer of the ordinary fur—fox, otter, fisher, marten, mink and muskrat.

Geological Features.

Archæan and Devonian Formations.

Huronian rocks, consisting of altered diorites, pyrites, gray quartz schists and some soft decomposed schists occupy the country to the south, extending as far north as the head of the first long rapid on the Frederick House river. The line of contact of this belt crosses the Abitibi below the Iroquois falls. From this point to the Lobstick portage Laurentian gneisses and mica schists crop out occasionally. The narrow Huronian belt from the Lobstick to the foot of the Canon or Long portage consists mainly of augite-syenite, passing into gabbro to the north. Beyond this portage Laurentian gneiss extends to the Devonian contact above the Sextant rapids. The whole region surrounding James bay is occupied by Devonian strata of sandstone, shale and limestone, the latter rock predominating. In these limestones Dr. Bell has reported gypsum and clay ironstone; the former only of these substances was seen. Superficial deposits Regarding the surface geology, the superficial deposits in the southern part is uniformly stratified clay. Farther north boulder clay is overlaid by sand and stratified clay. The mantle is of considerable thickness, reaching to 100 feet or more.

Missanabie River.

The return trip was made via the Missanabie river. In the following paragraphs will be found a short synopsis, dealing chiefly with the navigation of the river:

In the Devonian Belt.

From Moose island to the mouth of the Abitibi has already been described. For 16 Navigation of the River or 17 miles above that point the river is wide and shallow, with many swift places and three that might be called rapids, the last a fairly heavy one. Numerous islands occur here and the river is wide. Five miles up, after passing a mile of continuous shallow rapids, is an open stretch for a mile and a half through an extensive deposit of gypsum known as the White Rocks. Above these beds the river narrows and contains some large islands. I followed the northern channel and passed two hard rapids. Six miles above the White Rocks is Gray Goose island, past which the water runs with a stiff current, but is not shallow or rough. To Poplar isle and the junction of the Mattagami is about six miles of fair water. Above the fork the river is continuously shallow and swift for eight miles, beyond which is ten miles of fair water, but showing a good stiff current. Five miles more is a strong rapid and a mile beyond another with constant bad water to a small creek three miles above the last rapid. Above this creek are three rapids and then better water past the mouths of three rivers on the north side known as the [illegible], [illegible] and [illegible] rivers. Beyond the last of these is swift water and a rapid one-half mile up. A mile or two beyond the Poplar river enters on the south side. This is a stream of considerable size and serves well as a landmark. To two streams entering close together on the north side is ten miles. On this stretch bad water extends for a mile above Poplar river, followed by a piece of good water to three rapids separated by hard stretches of a mile each. Above these streams fairly smooth water extends for two or three miles, when we pass a small island. For four miles good and bad water alternate to a fairly hard rapid. From here to the Wabiska-gami river on the north are ten miles of good water. Coal river enters from the south 10 or 12 miles on. In this reach the water is good, broken only by two minor rapids about half way. The banks here are high and consist of clay, scarped in places, and showing deposits of lignite resembling those on the Abitibi. Eight miles beyond the Coal river the Missanabie turns abruptly to the south. Two miles beyond it passes out of the Devonian area and enters a Huronian belt.

In the Huronian Belt.

In the course of six miles southward we have a rapid, then two miles of fair water to three bad rapids. Above these is Landmarks of Rapids and Portages still another strong one which is best passed on the west side and a crossing made above to the foot of the Long portage on the east side. This portage is one and a half miles long and is fairly level. Above it, it is necessary to pole one and a half miles to the Stone portage of one-half mile on the same side. Between the Stone portage and the Riverside portage on the opposite side (three miles) are several hard stretches requiring poling and tracking. The Riverside portage passes a very picturesque gorge in which the river narrows to less than a chain: it is a half-mile long and level. Twenty chains of easy poling bring us to the Conjuring House portage, also on the west side: it is short and easy. A few miles of good water extend above this portage, when we enter a series of rapids, consisting of four main ones and some minor ripples. Good water extends to the mouth of a river of some size from the west known as the

wishquaia. Four miles farther brings
Lower Skunk island, before reaching
we ascend three rapids. There are
of these islands, known as Lower,
e and Upper Skunk islands. From the
it is five miles to the Kettle portage,
which are some rapids. The portage
he west side, and short. Above are
continuous rapids, then a mile of fair
to the Black Feather rapids, which are
heavy. The lower part was poled, but
he small canoe it was found necessary
tage the upper part. Five or six miles
d water, broken only by one or two
of no importance, bring us to the
Island portage of three chains. From
rtage good water extends seven miles
kagee rapids. They are fairly heavy ;
ut was found necessary at one point.

ween Kakagee and Sandy bay, a dis-
f six miles, are four rapids, the first
ht, the third heavy and the last at the
the portage. Sandy Bay portage is
on the east side and past a very pretty
Three miles of good water bring us to
Rock portage. This is a chain in
and over an island. Good water ex-
bove Sharp Rock portage for two or
niles, when a portage is necessary on
st side. Above, poling is required for
ins, when we make the Beaver portage
hains, also on the west side. Beyond
ter is swift, rendering poling neces-
r a short distance. Good water suc-
o the Albany rapids, a distance of nine
rom Sharp Rock. In these rapids the
broad and shallow and there is a con-
le fall. The rough water extends
or 30 chains and can all be poled.
lbany river enters from the west a
listance above these rapids.

n the Albany river to the Devil's
is eight miles, the first part of which
l water to a sharp turn known as
's Bend. Then succeeds swift water to
vil's rapids. At this point and above
e hard rapids ; I found it necessary to
three times, the last by the Sugar-
rtage on the west side. Twenty
above is the Achuter portage on the
le. Three miles of good water bring
he Double portage on the east side.
This portage is 25 chains in all, but is broken in the middle by a bay of the river, whence its name. The Brunswick river enters on the west side four miles above this portage. Four miles above the Brunswick river a hard rapid is caused by a spit of gneiss from the east side. Four miles more brings us to a small ripple followed by nine miles of good water to a heavy rapids requiring a lift-out. A small chute, with a drop of four feet, occurs three miles up. Six miles from here, after passing a river of some size, we arrive at St. Paul's portage on the east. A little rough water follows, and then good paddling to St. Peter's portage on the west side. In the next three miles are two long rapids to pole and then a half mile portage known as the Greenhill. It is on the south side and occurs where the river makes a bend to the north. It turns south again beyond the portage, and a mile brings us to the Wavy Rapid portage on the east side. Just beyond the river turns north again and we make another portage over an island. A short distance up is another rapid and a portage on the east side ; below it is a stretch of bad water and two small ripples above. Beyond the river resumes its southerly direction, and a mile brings us to a short portage on the east side known as the foot of Swampy Ground portage. This is followed by 14 miles of clear paddling through a level swampy district. A series of rapids follows. A portage on the east side of ten chains passes the first ; the next two must be poled, and the last may be run or may require a portage according to the size of the canoe. A little beyond a long rapid breaks the river for over a mile. It may in part be poled, but short portages are necessary. Another means of avoiding this obstruction is to make a half mile portage on the west side into the Nottawa river, which enters the Missanabie above this rapid. This stream is now so choked with driftwood that after descending 20 chains another half mile portage is required to regain the river. Three small rapids obstruct the navigation at intervals above the Nottawa. Clear water then continues for five miles, when two hard rapids occur. The first can be poled or tracked, while a well used portage of a few chains enables us to

pass the second. Three miles above this we enter Missanabie lake. The course is along the northerly shore, in a southwest direction, for 20 miles to a rocky point, where another arm from the north joins the lake. From this point we cross in a westerly direction to the opposite shore, follow it north for a mile and arrive at Missanabie portage. This portage of ten chains leads to a long thin lake ten miles in length. The Height of Land portage passes out of the extreme western end of this lake and enters Dog lake. It is short and somewhat swampy. Dog lake is very crooked and is crossed in three places by the Canadian Pacific Railway. From the portage to the station is eight or nine miles, but the route is so crooked that I am not in a position to describe it.

Crossing the Height of Land into Dog Lake.

Acknowledgements.

Before closing this report I wish to express to Mr. Niven, to Mr. E. Neelands and to Mr. W. S. Ritchie, members of his party, my sincere thanks for assistance afforded me during the summer. My gratitude is also due to Mr. Broughton of Moose Factory and to Mr. Jobson of New Post for valuable information and kindly treatment, and to the Very Rev. J. A. Newnham, Bishop of Moosonee. I am also indebted to Professor Coleman of the University of Toronto and Geologist to the Bureau of Mines for valuable advice and assistance in the preparation of this report.

GOULAIS RIVER TO DALTON.

By W. A. Charlton, Jr.

ɽSUANT to instructions received from he Director of the Bureau of Mines to pany the survey party of Mr. Speight, ., upon a Meridian Line to be run from rth end of the line between the town- of Hodgins and Whitman due north to ain line of the Canadian Pacific Rail- t or near Dalton, I left Toronto July 8, in company with Mr. Speight and his nts, and arrived at Sault Ste. Marie y following.

starting point of the line between the hips of Hodgins and Whitman could st easily reached by a walk of twenty inland from Garden river, but it was sary that some of the party should come h the canoes by way of the Goulais My instructions required me to pany Mr. Kennedy, forest ranger, in rips from the line, and to undertake a gical exploration of the tract traversed. quently I was detailed to accompany Kennedy into the country east of Batch- a bay, watered by the rivers Batchawana Chippewa.

In and Around Garden River.

arden
o
s

rden River, situated upon the Indian ve ten miles east of Sault Ste. Marie, is a most picturesque spot and well merits its name. The soil there is sandy, but fine crops of potatoes, cabbage, etc. are raised the pasturage is excellent. At Echo five miles east, the land is a good clay and is the centre of an industrious ng community.

e mile north of Garden River station, on oad leading to Hodgins township, we d extensive gravel beds, the property of Canadian Pacific Railway Company. nd these the country on both sides of oad is well timbered with maple and . For ten miles the road is good and lopes gradual, after which high rocky hills are encountered. Several swift running streams were passed, two with gray clay bottoms at the points of crossing. Along the roadway timothy was growing to a height of three to four feet, indicating that the country if cleared would make meadow and pasture lands of the first quality.

Rocks of the Cambrian System.

At about eight miles from Garden River a stretch of red sandstone crosses the road, and again near the eleventh and near the sixteenth mile similar stretches were passed. As we neared the Goulais river the country was seen to become very rough and mountainous, and from the hill-tops a good view of valleys well-timbered with spruce was obtained.

The Goulais River Valley.

Agricultural lands on the Goulais.

Where the road first reaches the Goulais river the Sault Ste. Marie Pulp Company have established headquarters for their winter camps. Here is a considerable clearing, and potatoes cabbages, turnips, carrots and onions were growing. The clerk informed me that this agricultural stretch extended, brokenly. one-half to one mile on each side far down the river. But above these camps the hills close in, leaving little level land between the river and the rough upland. The north bank of the river here is of sand and gravel, the south bank is a gray clay. A few miles from the headquarters of the Pulp Company's camps is a prospect owned by the Chicago Lumber Company. Samples of ore shown me were well mineralized with galena. copper and iron pyrites. I understand that a fifty-foot shaft was sunk in 1897, and that some drifting has been done.

Rock Formations of the Line.

Laurentian Gneiss.

For six miles above the camps the bed of the river is mostly gravel and sand, with stretches covered with large pebbles; a half mile west of the line and one and a half miles from its starting point is a series of falls, 35 feet in all, with a portage on the east bank three-eighths of a mile long. These falls are over rock of the Laurentian gneiss, and below the river bed is well filled with boulders, mostly weathered gneiss and granite. East of the falls is a morainic deposit of gravel and sand, here 120 feet high and extending northeast, along the eastern side of which a stream 20 feet wide flows southwest, emptying into the river. About four miles above the falls several clay banks were noted on the west side of the river, one 70 feet wide and 25 feet high of gray strata. The water trickling down these banks was cold but soft. At this season of the year the river is quite shallow, and the current being swift, averaging over two and one-half miles per hour, it is necessary to pole in ascending by canoe.

Mica and other Schists. At the second falls, near the 5th mile, a band of schistose rock 200 feet wide crosses the river, showing evidence of intense pressure and crushing. The rock is chiefly mica schist, but in places were sericite schists heavily charged with copper pyrites. A hard dark-gray rock with pitted surface walled the schists on the lower side. Up the bank, above the sweep of the water, this rock showed little circular masses of hornblende crystals upon the surface. Above the falls, on the east bank, rises a granite bluff nearly 200 feet high, and from the top of this a great number of similar risings were seen in the surrounding country.

Contact of Gneiss and Diorite. On a trip east of the 5th mile a hornblende-granite gneiss was encountered, but the general country rock is the mica gneiss. At the 8th mile a contact of the granite gneiss with an altered dark gray diorite occurs, the strike being west 10 degrees north. The diorite belt does not extend far, for two miles further on at the next exposure of rock, a wooded belt having been crossed, granite gneiss is again met. [illegible] a large [illegible] and [illegible] The [illegible] was granite gneiss [illegible] east and northwest and at this point was a perpendicular fall in the stream of [illegible] feet. The bed of the creek below and above was full of boulders, weathered granite, gneiss, diorite, diabase and some fragments of schists.

Slates and Schists. Between the 15th and 16th mile there is a contact with the gneiss of a coarse-grained, hard gray granitoid rock, north 10 degrees west, and this gives place beyond the 16th mile to an area of slate and hornblende schist. Chlorite and sericite schists were met with on the shores of little lakes in this vicinity and up to the 21st mile. Beyond the 21st mile granite-gneiss again appears prominently and continues unbroken to the 26th mile, where slate and chlorite schist cross westerly. Some lean-looking quartz veins were passed in this locality. Two miles east of 26th mile slate was passed close to a little lake, but this seems to be included in the gneiss which appears at the 27th and continues to 30th mile, showing much mica. Between 30th and 32nd mile several areas of hornblende schists were noted, and two miles west of the 32nd mile a contact was crossed west 10 degrees north.

Diabase Dikes. To the east of the line between 36th and 38th mile several parallel dikes of diabase cut through the gneiss in a northwesterly direction and west of the 37th mile diabase dikes, green schists and phyllite parallel to the first named were passed. East and west of the 36th mile the country is a succession of high bare bluffs, and the river a series of chutes and falls for some distance below the line. But a little northwest of the 37th mile, the land is lower and more level, the hills presenting the appearance of having been worn or ground down, being low crowned and flat and covered with a mantle of gravel and white sand. Numerous little lakes were passed here. About three miles west of 38th mile diabase dikes and small areas of hornblende schists extending northerly were observed. Between the 38th and 39th mile two little lakes cross the line, around the shores of which is much green schist. From the 39th to the 40th the country is well covered with white sand and organic matter.

A Branch of Montreal River.

A branch of the Montreal river crosses the line at the 40th mile, and beyond this the white sand extends three-quarters of a mile to a high

Laurentian gneiss which rises abrupt- feet and slopes to the west, meeting the Montreal river a quarter of a an mile west, the river here cutting through the rock and falling 35 feet e. We crossed the Montreal river again rvals up to the 51st mile, and during stance I followed the banks on foot. western bank, at about the 42nd mile, of intrusive diabase 600 feet wide cuts h the gray granite and gneiss north rees west. Several dikes of the same rock were passed while crossing the hills east of the river between the nd 45th mile, and a large area of saus- gabbro. These lay parallel or nearly l to each other, the strike varying from 0 degrees west of north.

n the 41st to the 47th mile the land y and uneven, with many high hills luffs, and the country rock is well nated with iron. At the 47th mile a stretch of comparatively level lands vered with sand, with areas of moss iskeg. This stretch extends brokenly 59th mile, and rock exposures show a grained crumbly biotite-gneiss through- is distance. A brulé extends from the the 54th mile.

ie 59th mile, on the north bank of the ran river, a hard gray medium- grained granite-gneiss succeeds the ind poor variety of the last ten miles.

Beyond the bank of this river there tle rock exposure up to the 73rd mile, untry generally presenting a rolling of muskeg and ridges with some hills l with sand and well wooded. East of h mile and extending to the north for niles and to the east for several miles, xtensive sand plain with stretches of ie.

attawan River to Lake Windermere.

September 19th Mr. Kennedy and Mr. Speight's camp to explore the of lake Windermere. We left at d and rejoined the camp at the d mile. Several bays of Windermere ntered and explored, rock exposures ig a common whitish granite-gneiss. beaches of white and red sands were noted, particularly along the south shore of the main body of water. From lake Windermere we followed the outlet west and north towards Dalton. Gneiss predominated, but areas of true granite were passed at points west of the 84 to 85 and 86 to 87 miles. Talc schists were observed west of 84 to 85 miles. About west of 88 to 89 miles the river enters an area of sand and gravel with banks varying from 10 to 30 feet high. We made a portage somewhere in this region crossing to a little lake, and thence over the sand plains to the railroad track one mile and a quarter east of Dalton. The next day was spent upon the hills north of lake Windermere, which presented seemingly a high gneissic glacial-swept area. Some prospecting has been done there this summer, and I was shown white quartz with galena. I crossed a considerable area of rock country, finding nothing but gneiss of the Lower Laurentian. Several dark dikes were noted, fused into the light country rock.

Gneiss and Granite.

Natural Resources of the Country.

The Goulais river is a swift-flowing stream, rising in springtime six feet above the level at this season. Its valley is well timbered with spruce, tamarac, balsam and other woods, with numerous spruce and hardwood (birch and maple) bluffs on either side. The river crosses and recrosses the line several times up to the 8th mile, where it turns, coming almost directly from the east. Three falls were passed between the 1st and 8th mile, and on two of these some blasting would be required for log-driving. No large stream was crossed after leaving the Goulais until we reached the 26th mile, where a branch of the Chippewa rises one mile west of the line. Between the 27th and 28th mile the first branch of the Batchawana was crossed, and subsequently the second and third branches between the 32nd and 33rd and 36th and 37th miles respectively. The general slope of the country so far is to the southwest, and a majority of the little streams met were swift flowing. Few lakes were met on our side trips, the country being very rough and uneven and unfavorable to reservoirs. From

Timber and water falls on the Goulais

and Batchawana rivers.

the 6th to the 30th mile neither cutting nor trail indicated that hunter or trapper ever visited this region, and there were but few signs of game. Beyond the 30th mile game is more abundant, and the country is visited chiefly by Chapleau Indians.

At the 36th mile the Batchawana river presents a series of falls, which we followed for some distance down. No portages showed that this river had ever been travelled through here. Above and northeast of the line the river is broader and quite navigable, and is connected by a chain of lakes and portages with Montreal river, the route entering the latter at a point about six miles west of the 39th mile.

Spruce, white Pine and Hardwood.

Some areas of white pine were passed or sighted on our side trips. Up to the 20th mile the country traversed was timbered chiefly with black birch and maple, except in the valley of the Goulais and its tributaries, which contains much spruce ; but other woods—ash, elm, cedar and tamarac—were noted as well. Beyond the 20th and up to the 30th mile the timber is smaller,—white pine, spruce, tamarac, and cedar, with extensive areas of poplar and white birch. Between the 30th and 33rd mile the wood is small, and of no commercial value, with no pine on either side of our course, but east and west of the 33rd to the 35th mile are both spruce and pine, with hardwood hills of maple and black birch. Between the 35th and 36th mile the line passes through a brulé, and the bare bluffs extend at least seven or eight miles to the west, while to the northwest and northeast are spruce and hardwood hills, and in the valley of the Batchawana to the east and north small spruce and balsam. West of the 37th to the 40th mile the timber is small with much underbrush of hazelwood, but at the line and to the east there is better growth of spruce, tamarac, birch and small maple.

On the Montreal River.

Spruce and white Pine.

Along the Montreal river from the 40th to the 51st mile, small spruce, balsam and tamarac, and some ridges of good spruce and white pine were passed. Along the hills to the east of the river blueberries, pink cherries and high-bush cranberries were plentiful. Spignet was found on the banks of this and the Mattawan rivers.

The brulé which was crossed from the 49th to the 54th mile was well-covered in places along the east bank of the river with rich long grasses. Blueberries and raspberries grew in great patches. The burned area stretches from two to four miles on each side the line and extends in a west by northwest direction.

To the east of the 54th and 55th miles lies a spruce and balsam valley, succeeded at the 55th to 56th mile by a muskeg area. Between the 56th and 59th mile the land is generally more rolling and better timbered with small wood—tamarac, jackpine, spruce, poplar and birch.

Mattawan River to Height of Land.

Thrifty Tamarac and Jackpine.

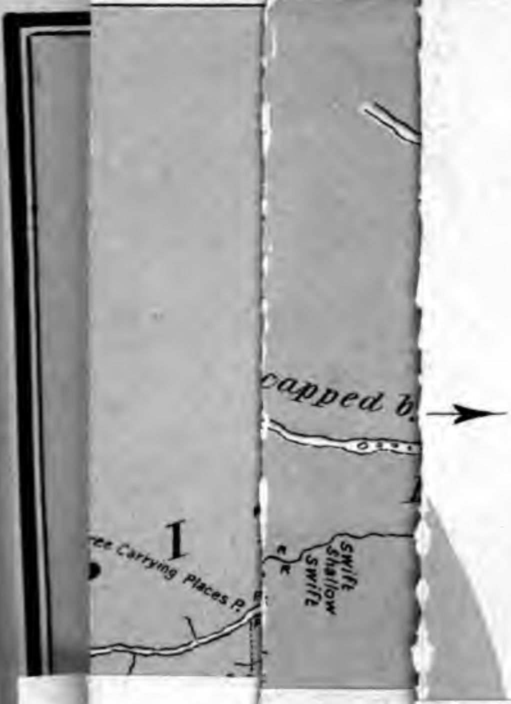
The Mattawan river, crossed between the 59th and 60th mile, is deep, crooked and somewhat difficult for canoe navigation It traverses a wide valley and expands at short intervals into small lakes. Large jackfish were caught in its waters. The river narrows, two miles above our crossing point, into a little unnavigable stream. Both banks are well timbered, chiefly with tamarac and jackpine. Considerable tamarac was noted in this section which would make five or six good ties per tree. The river empties into the Montreal three miles to the east.

Crossing the Water-shed.

Between the 60th and 64th mile the land rises to a higher level, the hills sloping generally to the southeast. From 64th to the 67th mile comparatively level areas extend on both sides of the line, and it was evident that we were crossing the height of land. From the 67th to the 70th mile is a rolling stretch of muskegs and ridges, timbered chiefly with tamarac and spruce in the lowlands and with jackpine, birch and poplar on the ridges. Underneath the white sand the rock is a gray gneiss.

A little Reservoir.

A small lake with much sand beach was crossed at the 70th mile. A navigable stream enters at the eastern end from the northeast, another from the south at the southwest, while the outlet flows northwest from the western end. Two miles beyond, at the 72nd mile, the line crosses between two large ranges of hills,



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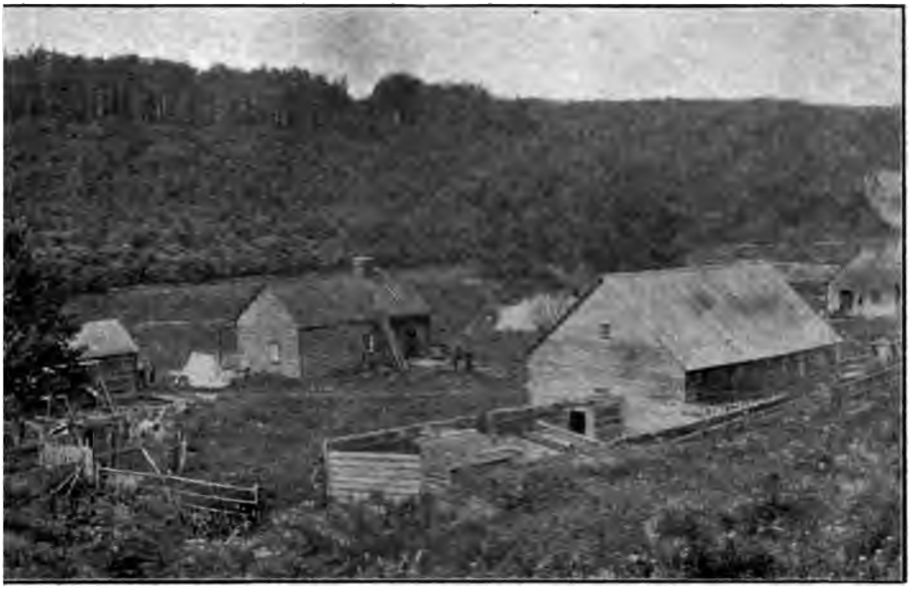
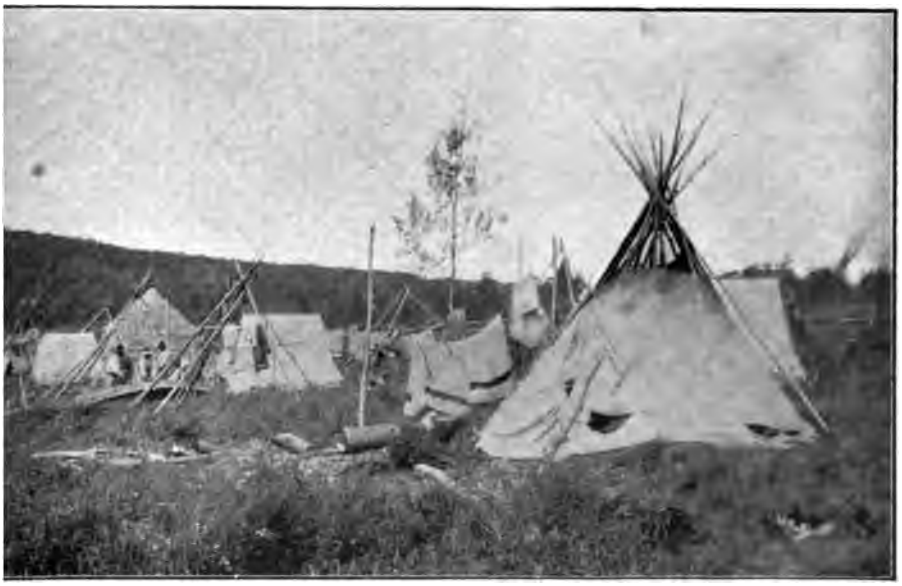
Abitibi Canon, looking south from level of River. —Parks.

Abitibi Canon, looking south from bank of the River. —Parks.



New Post (H. B. Co.) on Abitibi River. —Parks.

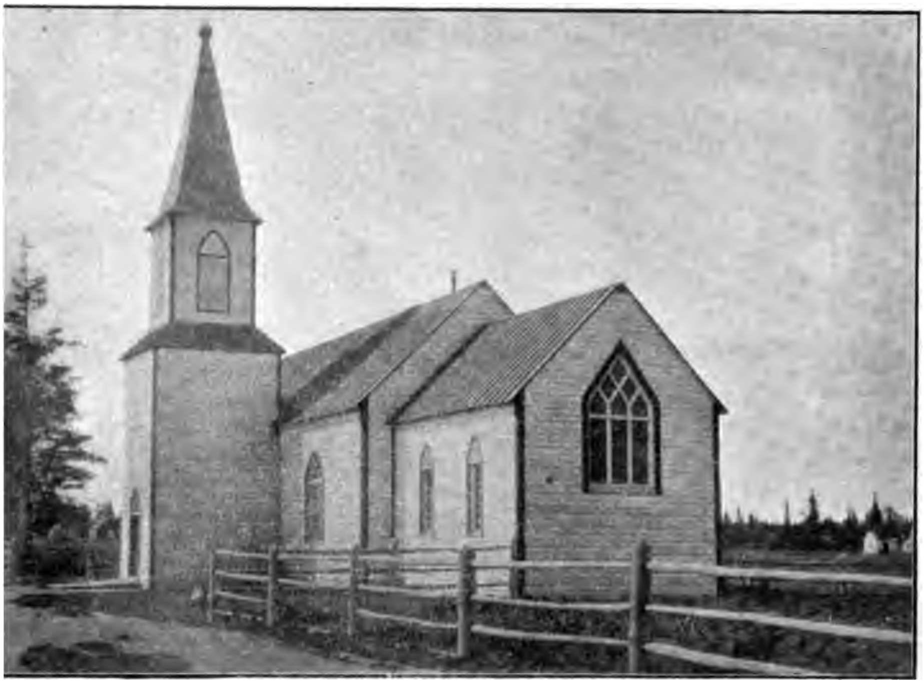


Indian Camp at New Post, Abitibi River. - Parks.

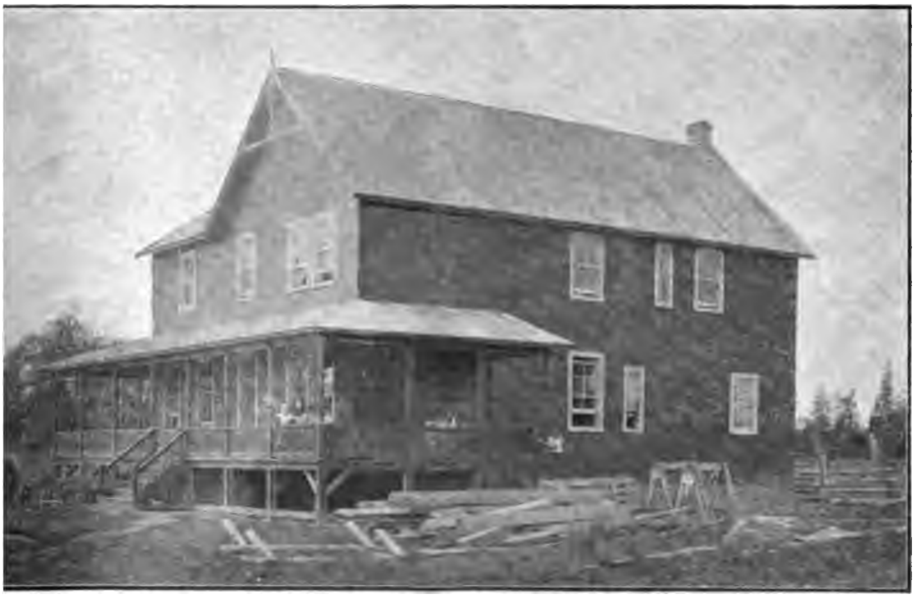
Camp on lower reach of Abitibi River. --Parks.

Lignite deposit on Abitibi River. —Parks.

Limestone Cliff at Sextant Rapids, Abitibi River. —Parks.



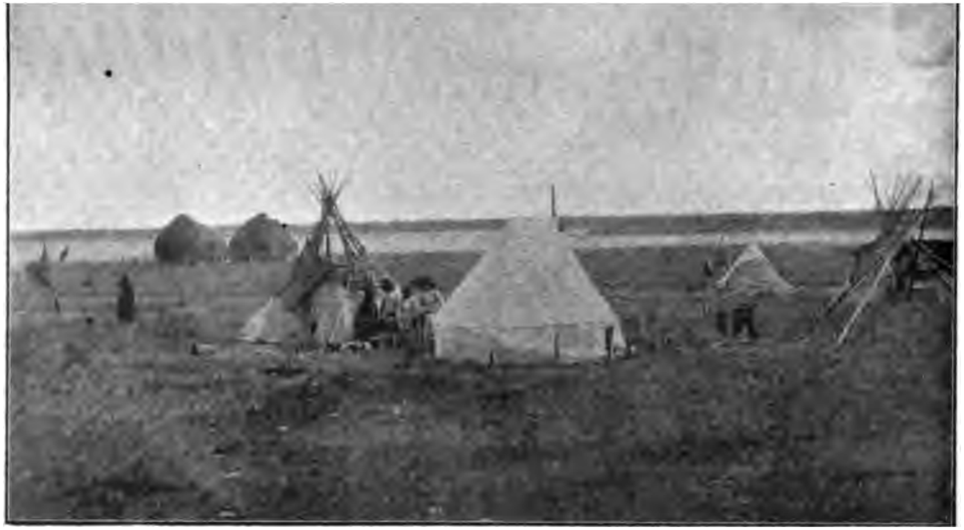
The Bishop of Moosonee's Cathedral at Moose Factory. —Parks.



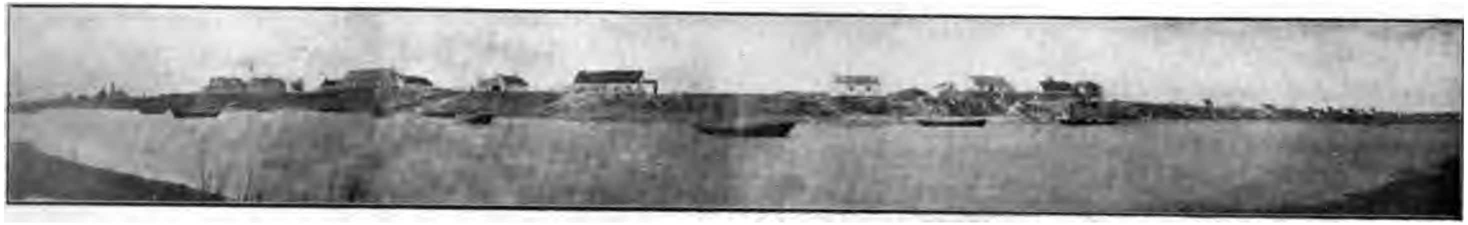
" Bishopscourt " at Moose Factory. —Parks.

Chief Factor's Residence (H. B. Co.) at Moose Factory. —Parks.

H. B. Co. Employe's Family at Moose Factory. —Parks.



Indian Camp on Moose Island. —Parks.



Moose Island, showing H. B. Co. Buildings of Moose Factory. —Parks.

n the west sloping to the northwest
ıse on the east to the northeast. We
d the outlet of the lake at the 70th mile
ıe four or five miles of its course, pass-
rough much marsh land with small
: and spruce on the sides. Several
s along the stream indicated that it
ravelled route. Five miles from its
it turns abruptly to the west and we
led that it probably emptied into the
icoton waters. Rock exposures along
nk were all gray granite-gneiss, with
arker exposures fused into the former
ll impregnated with iron. Returning
lake, the feeder at the northeast was
. This flows from a little lake about
and a half east of the 71st mile. Its
is entirely through low marshy lands
oor timber. To the east extends an
: muskeg and swamp. Two beaver
ere crossed. Beyond the lake to the
the 71st mile the country north and
es to a level sand plain crossed by a
two and a half miles long to a tribu-
f Prairie Bee lake. Windermere
s come in this way to hunt. The river
the portage is just three miles east of
d mile, and the country between is a
stretch of plain and muskeg. In the
arsh areas ground-cranberries were
the first we had seen in quantity.
ng down the river we passed through
ying region partly timbered with small
and jackpine.

ı, bare, rocky bluffs line the shores of
Bee lake to the south, southeast and
ee southwest. On the north the
der- hills are covered with a mantle of
s. sand and are well-wooded, chiefly
oplar and birch. Entering Winder-
ake we traversed several of its bays,
mbed some of its highest bluffs, the
country around its shores presenting a
n appearance—birch and poplar tim-
re hills of gneiss and sand beaches.
n Several families of Indians live at
t. the lake, fishing and cultivating
gardens. Whitefish, lake trout and
h are plentiful in Windermere waters.
utlet, called by the Indians "Bad
is for miles a succession of falls and
It is not a much travelled route and we had to cut our portages, which were numerous. It flows northwest until within two or three miles of Dalton, where it turns southwest, being joined at this point by the Missanabie and Dalton stream, and emptying into Michipicoton waters. Another water-way reaches from lake Windermere to Dalton, north of the C. P. R. track, but this is as bad as the first. A good canoe route extends south of the track from Windermere to Chapleau.

The Batchawana River Region.

Three days after leaving Mr. Speight's party at Sudbury we arrived at Batchawana bay and began our trip up the Chippewa river at once. Our camp for the night was at the foot of the lowest falls on the river, where the descent is about 75 feet, with a portage of half a mile on the left or north bank. At the upper end of the portage is a hard greenish rock of felsitic texture, which forms a natural damway where it crosses the river, so that the water of the stream could be backed here at very little expense and a strong power secured. Near the foot of the portage a trail was noticed rising from each bank of the river. This leads from Batchawana to the Government road which stretches from Sault Ste. Marie in this direction. The people of Batchawana hope that the road will soon be extended to their settlement and the rivers Chippewa and Batchawana bridged.

Waterfall on Chippewa River.

Up the Chippewa clay banks were frequently met with. High bluffs extend on the left side, but on the right is no mean stretch of river flats, well timbered with hardwood. These flats, if cleared, would make fine agricultural and pasture lands. Their cost and the labor expended in clearing might be more than repaid by the sale of hardwood, especially to winter camps.

Agricultural and Pasture lands.

North of the Chippewa.

Finding the Chippewa shallow and hard to ascend, we left it after a day and a half, on Thursday, October 6, and portaged inland north 5 degrees, east a mile and a quarter to Little lake. The country passed was a fine stretch of hardwood with scattered white pine, not large but solid and

Hardwood and Pine.

hrifty on the ridges and in the valleys. The lopes and ridges were well covered with a good sandy loam, intermixed with organic matter. Lake No. 1 lies about 200 feet higher than the Chippewa at the point where we left the river. We paddled three-quarters of a mile north and again portaged, going one mile north, 20 degrees east, to lake No. 2, travelling up a ravine between hills of gray granite gneiss. Considerable white pine was noted on the ridges passed and around lake No. 2. Crossing a little height of land we came to an old Indian camping ground and an extensive sugar bush. Years ago this country was well inhabited, but for some reason the game left or was driven out and is only now returning. From the old sugar bush we paddled across a little low-lying lake with pine upon its shores, and portaged into lake No. 4, a lake of legendary fame, whose tale our guide related as we paddled northwest a mile and a half on its waters. Large rocky bluffs line the shores, and a good deal of pine was observed.

An old Indian Sugar bush.

Green Schists.

North a mile and a half of lake No. 4 an area of green schistose rock was seen about half a mile in width, and striking west 20 degrees north we passed this in the low lying grounds of a former lake basin. Continuing half a mile north through good hardwood bush, maple and black birch, we came to another little lake, and having portaged from it 13 chains over a little height of land we entered the first lake, of the Batchawana system. The lakes of this system are easily distinguishable from those of the Chippewa by reason of the waters of the first named being dark and brownish colored, while those of the latter are clear as crystal. Speckled trout are found in nearly all the lakes. At lakes 6 and 7 we saw no pine. Going northeast up stream from lake No. 7 we came to a recently burned area which extended along our course for some miles. We now passed through a series of marshy lakes and streams of shallow water with much muck bottom. Many little portages were made and scattered areas of white pine noted. Small spruce, tamarac and balsam grew around the waterway. Turning to the southeast we again entered Chippewa waters. Numerous wolf trails were seen round one of the streams.

A Region of Lakes and Marshes.

To the east stretch a level plain, partly open and covered with dry mosses and a good growth of short coarse grass. Crossing a mile and a half of this open we came to a little stream and one-half mile farther to a heart-shape lake the shores of which were thickly wooded with small white pine.

Around Lake Chippewa.

After portaging we entered lake Chippewa, and here camped for three days, October 8 to 11, spending this time in exploring the country to the east and southeast of lake Chippewa. The whole of this district is well covered with hardwood, with scattered pine throughout and belts of pine around the lakes and in the valleys. An area of slate and diabase crosses lake Chippewa, striking north 40 degrees east. Three miles south of the same lake a diabase dike was crossed, and in the same vicinity quartz with magnetite and green schist walls. Samples from a quartz vein yielded traces of gold upon assaying. To the west of lake Chippewa hardwood ridges with little pine extend to the Batchawana river. North of the lake is a series of little lakes most of which are tributary to the Batchawana. To the east of these lakes is a pinery stretching to and beyond the Chippewa river.

Slates, Diabase and Veins of Quartz.

Wart Lake.

From a high bluff at the southwest end of Wart lake the country north, south and east could be seen for miles. To the southwest, south and southeast lay a country of hardwood hills and plains, ridges and valleys of pine, and extending, our guide said, through to the banks of the Goulais. But beyond Wart lake to the north and northeast a rough country was distinguishable, a great succession of bluffs, some timbered with spruce, but being for the most part bare rock,—the whole having the same appearance as the country crossed by our meridian line in this latitude. Gray granite bluffs surround the south and west shores of Wart lake, rising in places to an altitude of 350 or 400 feet.

The Batchawana Valley.

West of Chippewa lake the Batchawana river is wide and shallow. The bed is covered with large boulders and paddling in a birch canoe is slow work. Going down the

In the Laurentian area north of the 45th mile little or nothing was found, if the talc and mica schists of Bad river be execpted.

In the region of the Batchawana and Chippewa rivers were numerous indications of both copper and iron. A dull lead-blue slate was found on the shores of lake Chippewa. A quartz vein south of the lake yielded traces of gold. Magnetite and quartz associated were found in this vicinity.

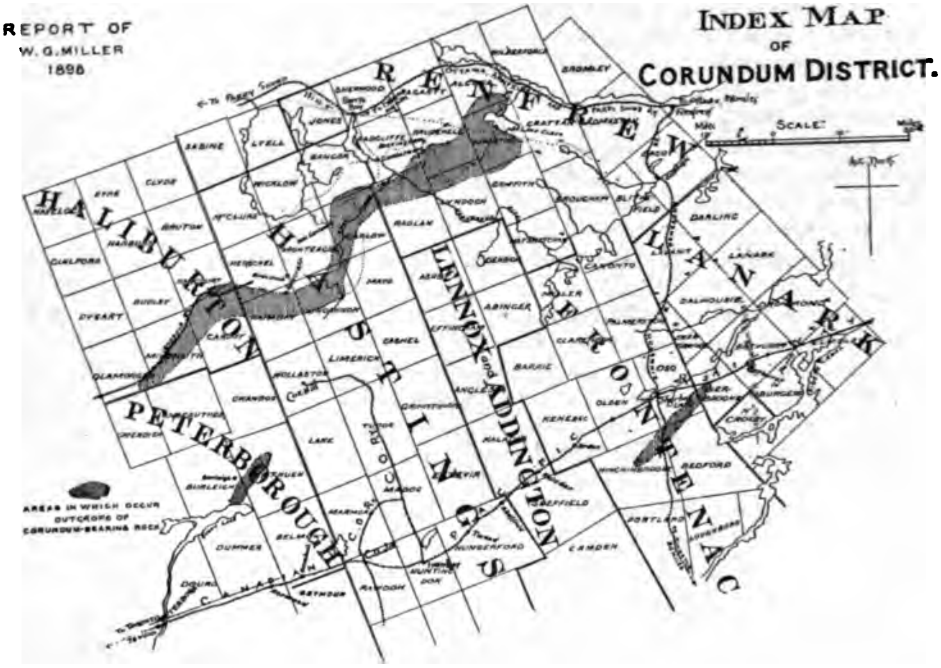
Copper and Magnetite.

Index Map of Areas.

The locations of these different areas of the corundum-bearing rocks are shown on the index map which accompanies this report (p. 198). It will be seen that the smaller belts are separated by a considerable distance from the larger belts, and that the three belts taken together partly surround a large district.

A primary Constituent of Syenites.

As stated in last year's report, the corundum occurs as a primary constituent in a series of rocks which may be classed broadly as syenite. Numerous varieties of syenite are met with in this field, both as regards size of grain and constituent minerals. In some cases the rock consists almost entirely of acidic felspar, pink or white in color. In other cases nepheline, mica, hornblende or corundum is present. Corundum also occurs in a locality discovered in 1898 in a rock which may be classed as a basic anorthosite. The corundum-bearing rocks often occur as dikes which cut through the overlying gneisses. At other times these rocks have the form of large masses which in some cases appear to shade off into granite. In the following pages reference is made to the chief characteristics of the rock in different parts of the field.



Peterborough and Haliburton.

Corundum associated with Mica.

The past season's work was begun in July in the county of Peterborough. I had paid a hurried visit to this township at the end of the season of 1897, but time did not permit me to determine the area over which the corundum-bearing rocks occur.

Townships of Methuen and Burleigh.

The mineral was first found in the township of Methuen in some deposits which were being worked for mica, and its occurrence here was made public shortly after the mineral was reported to occur in Carlow, where it was found by Mr. W. F. Ferrier in October, 1896. In my hurried visit to the locality in 1897 I determined that the rocks in which the mineral here occurred were similar in character to those in which we had found it in Carlow and other townships, although the mineral itself was considerably different in color from other specimens of it which we had seen in the region.

nning our work in Methuen last) pitched our tents on the property nown as the Bennett mine. It ras on this property the corunum was first found in the town-.e main buildings in connection property are located at the small lake, known as Mountain :hey are at the foot of a range of ı locally as the Blue mountains. , following the general direction of ıf the rocks, run in a northeast and lirection and have a length of five es. The Bennett property is ar their western end. This part ı is one of the most rocky and ıs from the agricultural point of I have visited in the district. posed at the surface over a large ıany of the hollows are occupied meadows and small lakes. Five be seen from one point at the l of the Blue mountains.

) of Methuen, made from the l822-3, is one of the poorest and ıost inaccurate of any of the town-ıip maps which I have tried to larger lakes are unrecognizable, t cases it is impossible to deter-)undaries of lots. In stating the ' points in this township I wish it rstood that in most cases I had no s to go by, and could not make inaccurate topographical features ın the map. The location of the ints referred to were determined as possible from information)m some of the older settlers, and lines which have been run during by persons interested in mining

nett mining location, on which e work has been done in mining .ica, comprises lots 14 in conces-ons nine and ten. The main ıildings are situated on the former on the north side of Mountain line between lots 13 and 14 runs southwest corner of the lake. ntain lake, which is a short dis-)f Mountain lake and in the same lies wholly in lot 13 of the ninth concession. The Miller location, across Mountain lake opposite to Bennett's, embraces the southeast 50 acres of lot 13 in the same concession and the northeast 25 acres of lot 12 in the ninth.

Work has been done at Bennett's near the shore of Mountain lake on the narrow strip of land which lies between the edge of the lake and the base of the hill or mountain, and also near the top of the hill some distance farther west. Where the work has been done at the base of the hill the country rock is a dark gneiss, which is composed for the most part of plagioclase and hornblende, together with some mica. Through this gneiss there are several dikes which cut it in different directions, but have a general trend at right angles to the adjacent shore of the lake and the base of the mountain. These dikes are similar in appearance to ordinary acid pegmatites, but are composed essentially of pink or light colored felspar and mica, both light colored and dark. There appears to be no primary quartz present in them. It is these dikes which have been worked for light colored mica. The dikes may be classed as syenite-pegmatite. Between the foot of the hill and the dark gneiss there is a rather deep ditch-like depression along the contact. The rock on this face of the hill and for some distance over the top is for the most part rather fine grained and light in color, but in places it contains grains and stringers of nepheline which is usually in coarser grains than the mass of the rock. In places the rock also contains abundant and often well formed octahedrons of magnetite.[2] The

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[2] A typical specimen of this rock of the Blue mountains, in which nepheline was not observed in hand specimens and which contained less magnetite than some parts of the mass, was analyzed by the writer and found to have the following chemical composition, which shows it to be a nepheline syenite :

SiO_2	58.27
Al_2O_3	23.75
*Fe_2O_3	1.86
MgO	trace
CaO	1.89
K_2O	5.17
Na_2O	6.90
Loss on ignition	2 80
Total	100.14

Sp. gravity=2.60.

*FeO is estimated as Fe_2O_3.

coarse dikes cutting through the gneiss, which have been referred to, are somewhat similar in composition to the mass of the rock in the hill, with the exception that those at Bennett's apparently do not contain nepheline. Some of the coarse dikes and parts of the main mass of the hill carry corundum. The dikes cutting the dark gneiss near the lake shore run towards the mass, but cannot be seen to run into it. It is evident from the similarity in composition of the dikes and the mass of the rock in the hill that the material of which they are composed has been derived from the same source. Some of the dikes on the Miller property, which has already been referred to, and which are similar to those at Bennett's, have been worked for mica and contain corundum and nepheline ; so that it would seem that these coarse dikes which cut the dark gneiss on both properties are composed of material of similar origin to that of the finer grained mass of syenite in the mountain.

Rocks of the Blue Mountains.

As has already been stated, the greater part of the rock in the Blue mountains, which run across country here for five or six miles, is composed of a light colored rock which may be called in general syenite, and which contains in places more or less corundum and nepheline. On the northern side of the hill the syenite seems to merge off into granite. Between the part of the hill on which the Bennett property is situated and the buildings of the Miller property, situated about one mile to the south, there is a depression which for a distance across it is occupied by Mountain lake and nearer the Miller buildings by a swamp. This depression runs for some distance parallel with the hill and, as stated, both Mountain lake and Little Mountain lake with the outlet of the latter lie in it. For some distance to the east of Mountain lake the depression is occupied by swampy ground. The rock which outcrops in this depression, on the borders of which is situated the buildings of both the Bennett and Miller properties, is chiefly the dark gneiss to which reference has already been made. This gneiss is bounded to the north by the syenite of the ridge known as the Blue mountains, and to the south by a thin strip of pink micaceous syenite which passes over into a granite of similar general appearance. At the Miller mine however there is a narrow strip of lighter granite near the syenite before the pink granite comes in. Although the syenite and granite are so similar in appearance, and hence seem to be products of one magma, still along the line separating the typical granite from the typical syenite there is a narrow swampy depression. At the Miller mine the office is situated on one edge of this swampy ground.

The general geological structure of this part of the field can then be described as consisting of a basin-like depression lying between the foot of the Blue mountains, where the Bennett buildings are located, and the vicinity of the buildings at the Miller mine. This depression or trough is occupied chiefly by a dark gneiss with which is associated, further to the east, some crystalline limestone. Outcropping on either side of this trough of gneiss we have syenite which both to the north and south, across the strike, seems to pass into granite. The gneiss in this trough would then seem to be a part of a synclinal fold of a layer of material which before being denuded probably covered the Blue mountains to the north and the syenite and granite to the south of the lake. Since the syenite outcrops on both sides of the trough of gneiss it would seem that this rock is continuous under the gneiss, and the gneiss may thus be considered to occupy a depression in the mass of syenite. The dikes of syenite in the gneiss, which have been referred to as having been worked for mica, may be considered as representing material which was shot through the gneiss at the time the igneous mass represented by the syenite was in a state of fusion.

Grenville Series and Fundamental Gneiss.

There are many areas of different sizes of the older gneisses and crystalline limestone isolated from one another overlying igneous rocks,—granites, syenites and basic members of the series—in this region. These areas represent for the most part what has been called the Grenville series, while the igneous rocks over which they lie or which have cut through them represent what is known as the Fundamental gneiss. The Grenville series in some parts of the region covers large areas, while in other places it is represented by small patches here and there which occupy hollows or other protected areas over the surface of the Fundamental gneiss, showing that at one time this latter group has probably been entirely covered by the Grenville, which has now been removed with the exception of the patches here and there which have been protected from denudation. These areas of Grenville over the Fundamental gneiss possess a similar arrangement to the outliers of Potsdam and later formations of the Palæozoic which are found in places in the region overlying the different members of the crystalline series.

Rocks of three Ages.

There are rocks of three ages usually associated with the outcrops of corundum. The oldest of these is a dark gneiss which is pretty uniform in character throughout the district. This can be seen to be cut through by the different varieties of syenite in which occurs the corundum. Then both the gneiss and the corundum-bearing series are cut through at times by dikes of coarse quartziferous pegmatite. This structure is seen in the township of Methuen, which we now have under consideration.

Syenites of the Blue Mountains.

The most striking topographical feature of Methuen is the range of hills known as the Blue mountains, to which reference has already been made. This range runs from about lot 22 in the sixth concession to about lot 14 in the eleventh, which forms its western end. The southern face and greater part of the range is composed of syenite. This face rises abruptly from out the gneiss, the line of contact between the two rocks being occupied for a considerable distance along the range by a deep ditch-like depression. The top of the range for the most part is comparatively free from brush and fallen timber, which have been removed by fires at different times. From the north face of the range there stretches out a low lying tract of country which contains little timber and is occupied by rocky knolls and ridges, composed for the most part of pink granite, between which lie innumerable marshy hollows. At places over this granite area are small patches or outliers of gneiss and crystalline limestone. At the western termination of the range of hills there are a number of coarse quartziferous pegmatite dikes cutting through the gneiss. There is one particularly large dike of this character in the vicinity of Jack's creek, about a mile to the northwest of the end of the ridge.

Granite of the Range.

To the south of the edge of the syenite on the Miller property the country is also underlain by a granite somewhat similar in appearance to that to the north of the ridge. This area of granite occupies most of the shores and islands of Koshkabogamog lake. On some of the islands and adjacent parts of the shore the granite takes on a distinctly porphyritic structure.

Granite of similar character shows in the area at the eastern end of Stony lake. It outcrops along the southeast shore of Jack's lake and some miles farther east along the North river. In fact the granite may be said to be the most abundant rock in this part of the township. Through this runs the Blue mountains, which are composed for the most part of syenite. From the western end of the range the syenite runs at a lower altitude to the shores of Stony lake. Over this lie areas of the gneiss and crystalline limestone.

An Outlier of Potsdam.

In addition to the areas just referred to, we discovered an outlier of rock of Lower Palæozoic age. This outlier belongs to the Potsdam formation. It has a diameter of about one mile, and runs from a little south of the Miller property to near the end of the southwest arm, known as Stony Lake bay of Koshkabogamog lake. This area of Potsdam presents a level surface which at once attracts one's attention on going in on the road which runs from the eastern end of Stony lake to the Miller mine. Not a great distance from the mine the road passes over a corner of the area. The vegetation on this Potsdam is also somewhat different from that of the surrounding Laurentian, and has caused the settlers to give to it the name the Oak Ridge. The Potsdam here has no great thickness, standing up not much above the surface of the Archæan.

Protection of the Potsdam.

The reason for this area having been preserved is quite evident when we examine the topography of the surrounding country. To the north there is the ridge of the Blue mountains, while to the south of the outlier, in the vicinity of the southwestern arm of Koshkabogamog lake, there are hills of granite. The area of Potsdam thus occupies a part of the trough-like depression between two tracts of high ground. It has thus been protected to some extent from denudation and prevented from being worn away as have other areas of Palæozoic rocks which at one time no doubt covered a considerable part of the surface of the township.

Lithologically the Potsdam rock which outcrops here in Methuen may be said to be made up of rather coarse pebbles of quartz and finer material of a similar composition.

Outliers of Potsdam occur at other points along the southern border of the Laurentian protaxis in the Province, but so far as the writer is aware this outlier in Methuen is many miles distant from any others of similar age which have been reported.

In this Potsdam conglomerate some concretions were observed similar to those known to occur in areas much farther to the east.

Limestone of Black River age lies on both sides of Stony lake, some distance from its eastern end. It may be seen in place not far from Crow's landing on the south side of the lake and north of Julian's landing on the north shore.

It may also be added that an area of Potsdam appears to be in place along a part of the shore just south and east of Crow's landing. A number of boulders were found not far from the edge of the lake, but as much of the rock along the cliff is covered by loose material we did not succeed in finding an exposure. On the road about one mile south of Crow's the Silurian limestone rises into hills. The lower beds of this limestone in places contain pebbles of considerable size.

Three Modes of Occurrence of Corundum in Methuen.

Corundum was first discovered in Methuen, as has been stated, in working a dike for mica. This was in one of the pits on the top of the Blue mountains on lot 14 in the tenth concession. At the surface of the ground no corundum was apparently observed, but on blasting into the rock the mineral appeared. On working down from the surface it became more abundant. In most of the dikes from which corundum has been blasted out the mineral is for the most part found as a core in the masses of mica. The corundum is often not observable in the mica until the latter is broken open, when it is found forming the centre or core of the mass. The rounded surface of the corundum and other characteristics leads to the belief that the masses of light colored mica are secondary products after the corundum. The relations of the two minerals are shown in Fig. 1. It might be added that the corundum shows a tendency to be segregated along the edge of the dike, and that as the mining proceeds to greater depths the mineral becomes more abundant at the expense of the mica.

In addition to the light colored mica, most of the dikes contain a dark variety which has a green appearance in thin layers. No corundum is found in the dark mica. The two kinds of mica in these dikes seem to have different origins. The light colored is apparently derived from corundum by the alteration of this mineral, while the dark colored variety appears to be an original constituent of the rock. Some of the light colored varieties have a purplish tint in thin layers in transmitted light.

There is another mode of occurrence of the corundum in which the mineral is found as the centre of ball-or nodular-like forms in the mass of certain varieties of the fine grained rock. These nodular masses in the rock are quite striking in appearance. The inner parts of them, surrounding the corundum, are composed of rather fine grained white felspar, which is surrounded by a mixture of the same felspar and dark mica. An occurrence of this kind is seen a short distance off the road to the Bennett mine, on lot 15 in the ninth concession, known as the Madill property. Some blasting has been done here. A reproduction from a photograph of one of these nodules is shown in Fig. 2, which accompanies this report.

iles are tough and difficult to break
hammer, and the photograph shows
ndum to have a somewhat radiated
.

nt minerals of apparently secondary
e found associated with the corun-
t a unique specimen was obtained
outcrop to which reference has just
le. This specimen consisted of mica,
nd corundum, together with a mass
a an inch or so in diameter. This is
specimen of galena that the writer
in connection with these rocks dur-
wo seasons of field work. Pyrites
is frequently found in the corundum-
eries in Carlow.

dum occurs in a third way in Meth-
this case the mineral is found in
asses or crystals scattered through
of the syenite, and is not enclosed in
mica nor in the centres of nodular
f differentiated rock. This third
ccurrence is similar to that described
ason's report in connection with the
in North Hastings and South Ren-
may be stated however that well
rystals are not nearly so common in
as in the other districts, and more-
e is considerable variety in the occur-
the mineral in the mass of the rock
ownship. One of these is that in
e mineral occurs in small mica-like
ith a bronze lustre on weathered
At first sight the mineral does not
be corundum. An outcrop of this
occurs on the Bennett property, on
of the ridge north of the shore of
untain lake and to the west of the
ldings. It is situated a little to the
t of the blacksmith shop on the top
ge.

ue mountains, as has been stated,
a southwest direction from lot 22
th concession on their northeast end
west of the Bennett property, lots 14
th and tenth concessions. Near its
end the ridge has a breadth of about
extending southward to within one-
f Koshkabogamog lake. Grassy lake
hollow in the ridge near its eastern
roughout its whole length the ridge
is composed for the most part of syenite, which seems to merge off into granite on the north. Corundum and nepheline appear at places in the syenite. The nepheline occurs at times in vein- or stringer-like forms through the rock. At other times it occurs in large masses in the comparatively fine grained syenite. Some of these masses, which generally have a rounded surface, have a diameter of a foot. Such masses of the mineral often occur isolated from one another. In addition to the dikes which have been opened up on the Bennett property, there are others near the southern face of the ridge at two or three points to the east of this. In several cases the rock has been blasted out in the search for mica.

The fine grained syenite which was referred to as outcropping near the buildings on the Miller property has a strike in the same general direction as that of the ridge of Blue mountains which lies about a mile to the north. This syenite of the Miller property consists of pink felspar and dark mica, and contains the characteristic small octahedrons of magnetite which have been spoken of as occurring in the syenite of the Blue mountains. From the buildings on the Miller property this band of syenite runs eastward and crosses the northwestern arm of Koshkabogamog lake, which here forms a narrow bay about 300 yards from its end. At the points where the syenite comes in contact with granite on the shores of this arm the contact is marked by two small bays on opposite sides of the larger bay or arm.

As has been already stated, there are coarse dikes of syenite which cut the dark gneiss in the vicinity of the buildings on the Miller property and which outcrop near the contact of the fine grained syenite and the granite. Two or three of these dikes contain corundum, in addition to the mica for which they have been worked. One of them lying the farthest east of those which have been worked carries in places a high percentage of nepheline. In one of the larger dikes there are a number of secondary minerals, among which were noticed quartz, occurring in geodes and stringers, tourmaline of a black or in some cases bluish color, calcite, pyrite, marcasite and chalcedony.

Syenite outcropping on Stony Lake.

From the end of the Blue mountains, near the western side of the Bennett property, the syenite rocks, carrying corundum in places, run southwestward at an altitude similar to that of the surrounding country to the north shore of Stony lake, and are continued on to a small island not far from the shore. This island belonged to the late Mr Craig, M.P.P., of Fergus, and there is erected on it a summer cottage. This cottage is nearer the east end of the lake than are any of the other numerous cottages which are situated on the shores and islands of this pleasant summer resort. The strike of the rocks changes near the shore of the lake, and runs in a more nearly east and west direction through the islands of the lake than does that of the rocks to the northeast.

The island, which is composed for the most part of syenite, lies two or three hundred yards to the southwest of a point on the shore which is also composed of syenite. The small islands along the shore a little to the east are composed of fine grained pink or grayish granite. On the point itself there are two or three dikes which carry a little corundum. The island has a breadth of 75 or 100 yards, and on its northwest side there is a small band of dark gneiss about ten yards wide. There are also some narrow bands of this rock in places through the syenite. Some dikes of quartziferous pegmatite cut through the syenite on the island. The height and breadth of the island are greater on the east, and it narrows down towards the west.

Syenite of two colors, pink and white, occurs on the island, and these two varieties are quite sharply separated from each other. The white syenite runs through the centre of the island, and is bordered on both sides by the pink variety. The white variety has a width of about twenty-five feet. The white syenite can be seen as a white streak on the island for some distance from the northeast on the main shore, as it stands out so distinctly from the pink on its edges. About ten yards from the northwest corner of the cottage, down the face of the hill of the island, there is a segregation of bluish and grayish corundum in pink syenite. The largest of the pieces of corundum showing here has a diameter of between three and four inches. Corundum is also scattered in places on the island through the white fine grained syenite. Six or eight yards from the front door of the cottage nepheline shows in patches in the white rock. The individuals have a length of one or two inches. This island contains in small compass what may be called a synopsis of the geology of the corundum-bearing rocks and of the rocks which are commonly associated with these in the district. It lies in the tenth concession of the township of Burleigh.

On the main shore, a hundred yards or so to the west of the island, crystalline limestone is in place. The strike is about N. 30° E., and the dip is about 60° to the southeastward. This limestone is rather fine grained and close in structure. It is somewhat impure and is dark gray in color.

About one mile west of the island, along the main shore, there is a quarry of biotite granite, and further west down the lake there is another granite quarry which was opened years ago on Eagle island. Granite from this quarry has been shipped to Toronto and other places as a road material.

Coming down the channel on the south side of the lake and near the east end the passage is seen to lie along the contact between two series of rocks. The islands on the north of the channel are composed for the most part of granite, while the shore of the mainland is composed of schistose rock, some of which appears to be impure crystalline dolomitic limestone. The strike is here N. 70° or 80° E. At the entrance of South bay, near the eastern end of the lake, the strike is N. 20° or 30° E. On the east side of this bay porphyritic granite is exposed, and this rock is also exposed at the extreme eastern end of the main part of the lake. Here at the head of the lake there is a small exposure of crystalline limestone which has a breadth of 10 or 15 yards and a strike of about N. 20° W., which is quite different from the general strike of the rocks of the area in the vicinity. The limestone has a dip of about 60° to the westward and is seen to be cut through by the granite, which thus accounts for the peculiarities in its dip and strike. The limestone band has been arched up by pressure from beneath at the time o ion of the granite. At Hull's land- the mouth of Jack's creek, the rock soid mica granite.

ian's landing, in the fifth concession gh, the lake is bordered by a band ntian rocks which has a breadth of half a mile. To the north of this limestone comes in. This area of has a breadth here of about one and miles and extends east and west tance. Little Cedar lake, which part of lot 8 in the fifth concession of adjoining lots, lies in the con- een the Silurian and the Lauren- to the north. These hills are high oon and Big Cedar lakes, and in cut through by quartziferous peg- Considerable quartz, which runs the granite in vein-like forms, has d out of the rocks. This quartz has lassy appearance. Several samples neral from the surrounding district d to contain no gold. An outcrop in schistose rock near the boundary and 6 in the first concession of the of Harvey however showed a $2.25 in gold per ton from samples by the writer and examined by the l Assayer. This outcrop of quartz shore of the lake and is situated a ance from Burleigh Falls.

is a good water power at Burleigh d a short distance to the northwest k has been done in examining the rocks, to which reference has been lithographic stone. The rock here in character to that which has been for lithographic purposes in the of Marmora to the east.

ad running from Burleigh Falls to illage in the southeast corner of the township of Anstruther is known as the Burleigh road. A branch road runs from Julian's landing d and joins the Burleigh road at the sixth concession of Burleigh . From this point northward to he road keeps pretty close to the Eel's creek, which it crosses at two places. Along this road to Apsley, exception of syenite, a similar as- of crystalline rocks is exposed to that which has been described as occurring farther to the south and east. After crossing the area of Silurian limestone, which has been described as lying a short distance north of Julian's landing, the road traverses a wide band of crystalline limestone, interspersed with black gneiss. The crystalline limestone is cut by numerous dikes of granite, which carry considerable tourmaline and some magnetite.

From Apsley a trip was made down the Wellington road and a camp was established on lot 21 in the fourth concession of Methuen, at the edge of the stream known as North river. Work was carried on with this point as a centre for a few days, our object being to trace the corundum-bearing syenite belt farther to the northeast than we had succeeded in doing while camped on the Bennett property.

A considerable variety is shown in the rocks going from Apsley down to where the road crosses the North river. Most of these may be referred however to classes already spoken of in connection with other parts of the district. A short distance east of Apsley a quartziferous pegmatite dike was seen cutting through crystalline limestone. The dike attracted attention from the fact that it contained considerable graphite as a secondary constituent. This mineral was found to fill numerous cracks in the dike matter and was present in sufficient quantity to have caused someone to sink a shallow pit on the dike in search of a workable deposit of it. This graphite is evidently a deposit from liquid matter similar to deposits of anthraxolite, in which the mineral is found coating crystals of other substances, as in the deposit a few miles north of Kingston and in other localities in Ontario.

A vein of barite about an inch wide was found projecting above the surface of the dark rusty gneiss alongside of the road in the green bush about a mile and a half down the Oak Lake road from its junction with the Wellington road.

Some pits have been sunk in the rusty gneiss on lot 26 in the fourth concession of Methuen. The rock contains some copper pyrites and pyrite.

The country was examined for some distance on all sides of our camp on the North river. To the east of the camp, and extending down past the eastern end of Koshkabogamog lake, the surface is composed of hillocks and small depressions which are pretty free from soil and timber. The area in fact represents the surface of a large granite mass, and shows little variety in structure Some of the granite here, like that occurring around Koshkabogamog lake, previously described, possesses a well-marked porphyritic structure. A short distance west of the camp a band of dark gneiss comes in and has a considerable breadth. Over some parts of this gneissic area there is a thick hardwood bush. About a mile to the west of the camp a small band of coarse pyroxenite was observed. This rock is similar to that which has already been referred to as occurring north of the Blue mountains, some distance to the southwest. Associated with the dark gneiss here, in places, were small segregations, syenite-like in appearance and containing octahedrons of magnetite. No undoubted outcrops of syenite however were seen northeast of the end of the Blue mountains. At their northeast end these mountains, which should properly be called hills, show a face running northwest and southeast. The axis of the mountains themselves, as has been stated, runs northeast and southwest. At their northeast end along the face to which reference has just been made they have a breadth of about one mile. To the north of their northeast end the mountains are bounded by a green hardwood bush, which is underlain in its eastern part by dark gneiss and farther west by crystalline limestone. The gneiss lies along the foot of the syenite hill in a manner similar to that which it has been described as doing near the edge of Mountain lake on the Bennett property. The gneiss is here also cut by dikes of coarse syenite. It would seem that the syenite disappears here under the gneiss. There is a small lake on or near lot 19 in the fifth concession. It is known as Burritt's lake, and it lies about one half mile from the end of the ridge.

Township of Chandos.

Having completed the examination of the rocks within easy access of our camp on the North river, we went across country, following in a general way the strike of the gneiss, to lot 26 in the third concession of the township of Chandos, coming out on the Wellington road. This road runs between the second and third concessions. The branch road which we had taken going down to our camping place on the North river turns off from the Wellington road near lot 21 in the second concession.

Deposit of Magnetite.

There is a deposit of magnetite on lot 27 in the second concession of Chandos on which some work was done some years ago. This deposit lies in a valley a little north of a small lake with swampy shores, known as Devil's lake. The valley appears to owe its origin to the weathering out of a narrow band of crystalline limestone, some of this rock outcropping along the valley. The deposit, judging from a hurried examination of its surroundings, is situated near the contact between granite which lies to the west and schistose rocks to the east. The magnetite is fine grained and the ore body appeared to have a width in places of five or six yards. A pot hole with a diameter of three or four feet has been excavated in the surface of the ore body, probably during the glacial period. There is also a deposit of magnetite on lot 30 in the second concession of Chandos, but we did not visit it.

Mica Syenite at Coe Hill.

Along the road a little west of lot 26 in the third concession there is a pink colored rock which has the appearance of syenite and is similar to the material in an outcrop between the station and the iron ore body at Coe Hill, specimens of which were collected by the writer some years ago. The rock at Coe Hill proved on examination to be a mica syenite. The outcrop on the road west of lot 26 in the third concession of Chandos shows at the surface for about one mile past the school house and side line. The mass cuts a crystalline conglomerate-like rock.

Country around Apsley Village.

The country was examined for some distance around Apsley. Numerous dikes of light colored quartziferous pegmatite were observed. These dikes in many cases carried black tourmaline and they were examined with a view to the discovery of some of the rarer minerals which frequently occur in this association, but without success. On lot 27 of the third concession a so-called mica deposit was examined by my assistants, who obtained specimens of rock from it which were composed essentially of white mica and quartz and were similar in appearance to greisen. The rocks also carried some tourmaline and hematite.

On lots 10 and 11 in the tenth concession of Chandos within a short distance of the shore of Loon lake there is an outcrop of rusty gneiss which has attracted some attention from prospectors, as have similar outcrops in which test pits have been sunk in the search for gold in different parts of the district. The rusty appearance is given to the gneiss through the decomposition of iron pyrites, with which mineral the rock is often highly impregnated. The mica schist associated with the gneiss carries garnets. A little zincblende was found in some of the crystalline limestone alongside of the road near school-house No. 1. The strike of the rocks east and northeast of Apsley is more nearly north than that of the rocks near Stony lake.

Crab lake, which lies west of Apsley, is surrounded by hills of gneiss whose strike is about east. The gneiss is cut by numerous quartziferous pegmatite dikes.

Township of Cardiff.

Traces of Nepheline Syenite.

My assistant Mr. Hodgson examined the country around Pandash lake. Some gneiss, syenitic in appearance, was found by him near the east end of the lake. Fairly well rounded boulders of nepheline syenite were found near the school-house, lot 30 in the tenth concession of Cardiff. A large angular boulder of nepheline syenite four by five by nine feet in size was found on lot 23 in the seventh concession. Other boulders were found on lots 27 and 29 in the ninth concession. On the latter lot a syenite-like gneiss was observed in place. The boulders were followed north through lot 29 in the eleventh concession, and a ridge of what Mr. Hodgson called syenite running N. 20° E. was found on lot 30 or 31 in the fourteenth concession. A ridge of very fine grained crystalline limestone occurs on lot 29 in the same concession. On the top of the ridge a large boulder of pink syenite carrying magnetite and weighing about two tons, was found. Working west from Cardiff and following the road leading to Gooderham station of the Irondale railroad, boulders of syenite were found at one or two places along the new road north of Cheddar post office.

Monmouth and Glamorgan.

Nepheline Syenite and the indications of Corundum.

Pink syenite was found in place on lots 16 and 18 in the eighth concession of Monmouth. On lot 15 of the same concession an extensive development of nepheline biotite-syenite was observed. A sample of dark corundum was obtained in the syenite here. The variety of syenite referred to passes into a white variety free from dark mica. Pink syenite occurs bordering the nepheline variety. The syenite is cut in places by granite dikes. At lot 29 in the seventh concession of the township of Glamorgan nepheline syenite outcrops alongside of the railroad track. Syenite containing nepheline outcrops near the road on lot 32 of the same concession.

An outcrop of nepheline syenite was mentioned in my last year's report as occurring on lot 30 in the third concession of Glamorgan. Some blasting has been done in the rock here, it being thought by those who did the work that the blue color of the sodalite which accompanies the syenite indicated copper. This year other outcrops of coarse nepheline syenite were found about a mile east of this one, on either side of the concession line.

There is a very good waterpower at the High falls near the line between lots 5 and 6 in the sixth concession of Monmouth.

Along the road at lot 9 on the seventh concession of Monmouth there is an exposure of crystalline limestone which is cut by light colored dikes of pegmatite. Just east of this nepheline syenite appears. The rock here contains hornblende, and is coarse and gabbro-like in appearance. There is a rather narrow strip of the rock here and then comes in a band of somewhat similar rock, and then going eastward there is an exposure of crystalline limestone carrying apatite and graphite. A little west of Hotspur P. O.

A Syenite Ridge near Wilberforce Station.

where the road branches off towards Wilberforce, there is a prominent exposure of nepheline syenite alongside of the road. The dark mineral in the rock is here chiefly black mica. The rock also contains a little corundum. On the road going towards Wilberforce, about one-half mile from the turn just referred to, there is a hill to the right of the road and a valley to the left. This hill is composed of syenite. Much of the syenite contains considerable magnetite. A belt of syenite lying about parallel with the railroad track and to the southwest of it was traced from this point to the vicinity of Wilberforce station and has a length of eight or ten miles. Going east from Tory Hill station by the wagon road, the rock outcrops along the road at a number of points after passing the summit of the hill. Just beyond Alfred Reid's farm buildings the road runs through a rather striking pass in the syenite ridge. Nepheline syenite containing a little corundum was found near where the ridge approaches the railroad track on Mr. Graham's farm, lot 28 in the thirteenth concession, a little south of Wilberforce station. Outcrops of the rock were also examined on lots 21 and 23 in the eleventh concession, and lots 27 in the twelfth and thirteenth concessions. In working eastward from Wilberforce a ridge of nepheline syenite was observed near the point where the wagon road first crosses the railroad, lot 7 in the twenty-second concession of Cardiff.

Corundum near Leafield P.O.

Proceeding along the wagon road towards Deer lake station, boulders of white syenite carrying brown corundum were found a short distance to the northwest of Leafield post office, lot 24 in the twenty-second concession. The boulders were quite large and angular. One of these lay at the roadside just over the brow of the hill before coming to the post office, and several others were noticed in the field to the right. From the post office a prominent hill of white rock can be seen lying across a ravine about half a mile to the eastward. It was thought that these boulders had likely come from this hill, and on making an examination of it corundum was found in place. Some of the syenite in the hill has a quite strongly marked porphyritic
Syenite shows at the road-side a
mile to the southeast of the post-o

Herschel and Faraday.

Connecting Corundum Areas in Cardiff, Herschel and Faraday.

There is an extensive devel
syenite with, in places, coarse n
stringers around the no
of a small lake and along
road for half a mile just
ing the summit of a high
lies near the point wher
ships of Cardiff, Herschel and Fa
together. The syenite has a stri
N. 30° W., and can be traced in th
for a considerable distance from
This brings this area into the s
rocks as the areas to which ref
just been made, and which may
follow in a general way the line o
dale Railway from a little to th
Gooderham station to the vicini
Lake station. The area lying ne
tion of the three townships refe
be shown later to be connected w
crops of syenite lying farther to th
in Faraday, and also with thos
gannon.

The outcrop occurring near the
the three townships is bordered o
east by crystalline limestone and o
west by gneiss. Many of the
this rock in the district are asso
crystalline limestone. In fact th
are so commonly found togethe
explanation seems to be require
frequent association. This poi
referred to again.

In the Eastern part of Faraday.

The village of Bancroft, the
which is wrongly marked on so
situated on lots 60 and
road, which runs along
boundary of Faraday.
is underlain by syenite, and out
rock occur along the York Branch
runs through the village, and at
in the vicinity. The southern
syenite, where it comes in contact
line limestone, is at the rapids a
mill at the edge of the village.
the rock here is about N. 80° W. a
of dip of the limestone is about

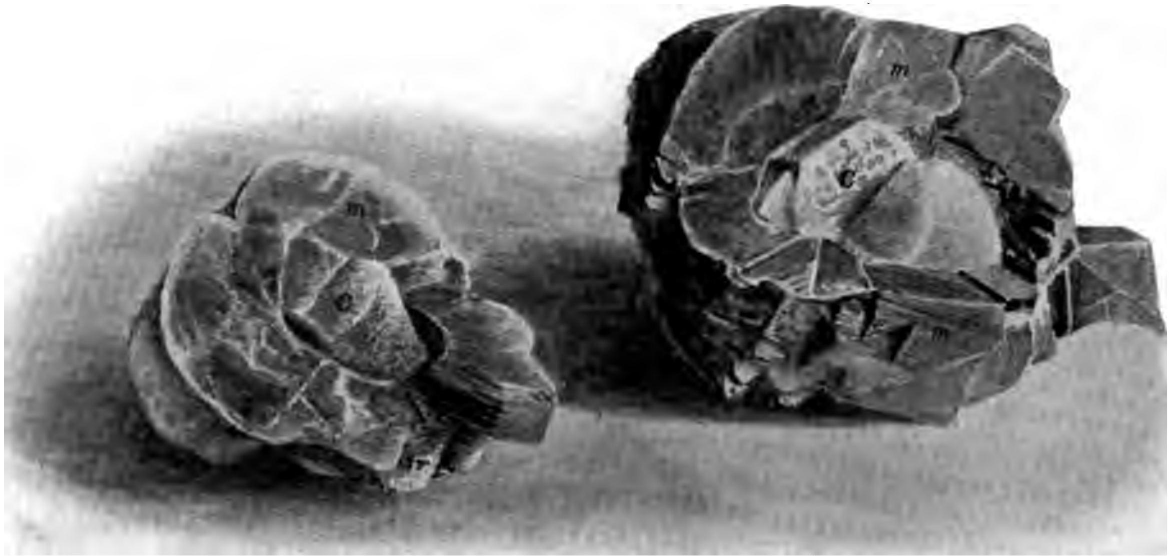


Fig. 1. Corundum, c, forming core of mass of Mica, m (p. 210). The figure shows the parts produced by breaking the mass in two. The Mica is evidently an alteration product of the Corundum. Bennett Mine, Blue Mountains, Township of Methuen. Natural size. From a drawing by William Revell.

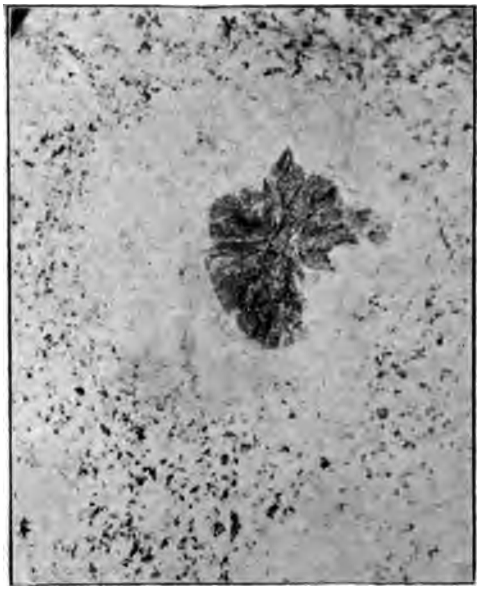
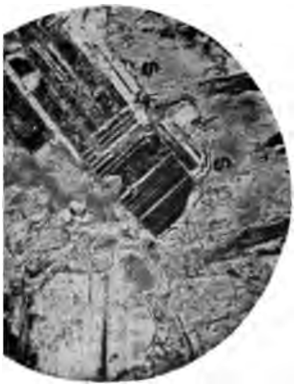


Fig. 2. Corundum in centre of nodular mass of differentiated Syenite, (p. 210). Lot 15, tenth con. Methuen. ⅔ natural size. —Miller.



tomicograph of thin section of Norite. (p. 228). The Plagioclase shows twinording to the Albite and Pericline laws, artly surrounded by its alteration pro-
polite (s). —Miller.

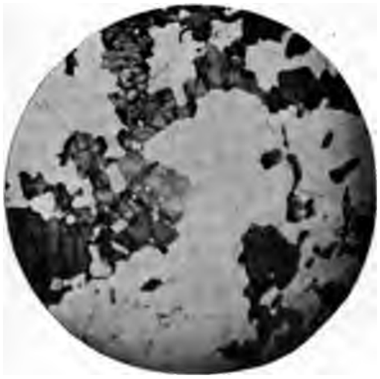
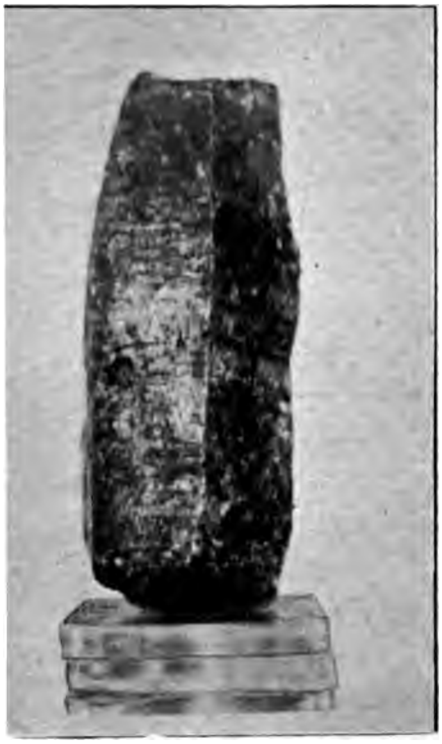
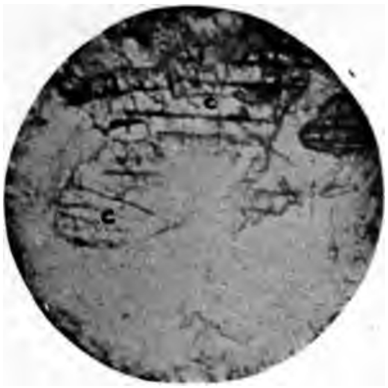


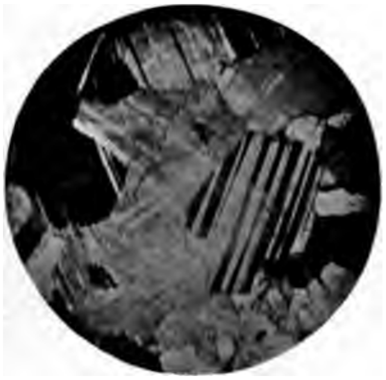
Fig. 4.—Photomicograph of thin section of Scapolite-hornblende rock (p. 229). Glendower iron mine. —Miller.



tal of Corundum, Raglan Township. Size 4 by 1¾ inches.
—Miller.

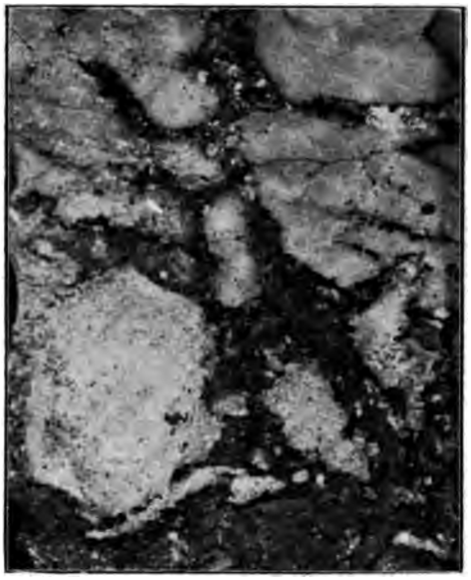


Photomicograph of thin section showing Corundum in Nepheline Syenite. The figure brings out the parting planes in the Corundum. —Miller.

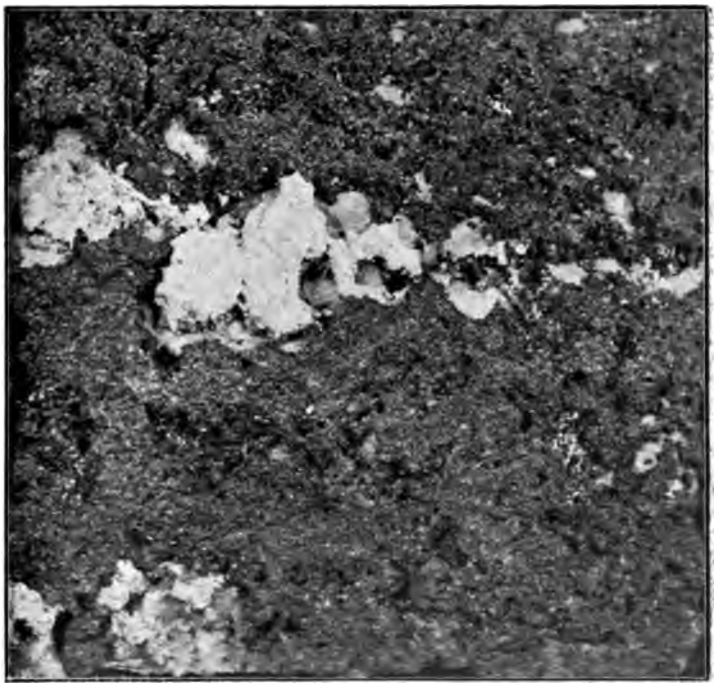


Photomicograph of thin section of Anorthosite from South Sherbrooke (polarized light). —Miller.

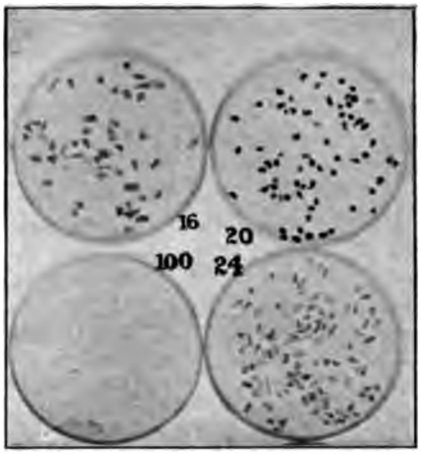
Corundum in Anorthosite, in sixth concession of South Sherbrooke. Miller.



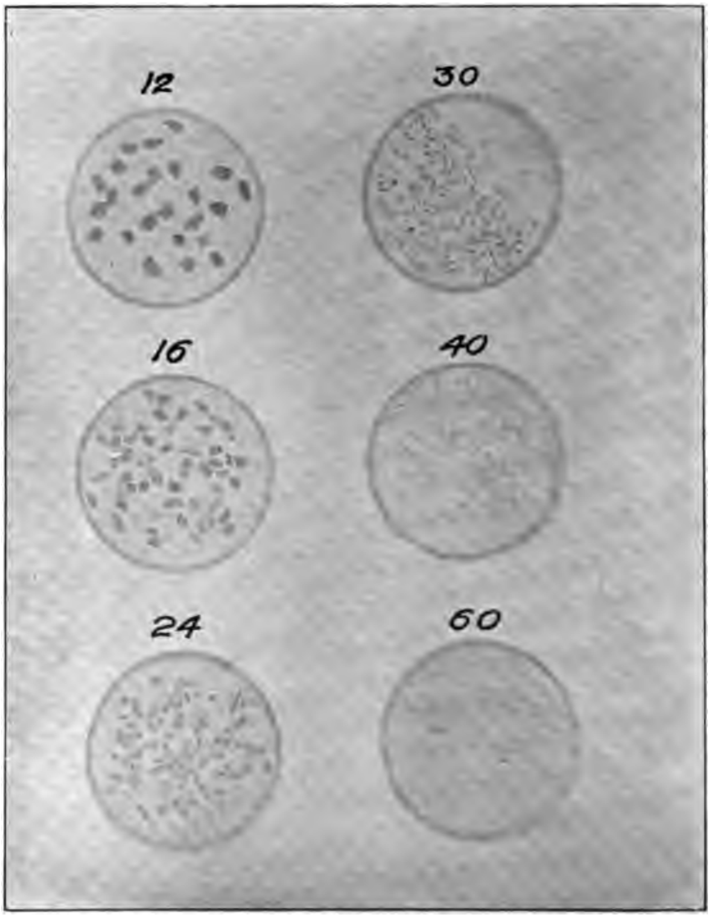
Weathered surface of rock composed of Nepheline and Felspar, the latter mineral being discolored by Oxide of Iron. Natural size. —Miller.



31 Weathered surface of rock showing Nepheline associated with Hornblende, Garnets, and Felspar. Township of Lyndoch. —Miller.



X-ray Photograph of corundum grains.—No. 16, 24 and 100 represent grains of Ontario corundum of the numbers indicated by these figures. No. 20 represents grains of so called ruby corundum from the southern U. S. The photograph shows that these grains are not corundum, as they are scarcely permeable to the X-rays. X-ray photographs offer a means of determining the purity of commercial samples of grain corundum. —Miller.



X-ray Photograph of Grain Corundum. Natural size. —Miller

ard. The syenite shows in places for half a mile along the Hastings road ıf the village, and is associated with a ·ystalline limestone. The rock border- ı syenite belt to the northward is a id granite, which rises into quite pro- hills.

g the western edge of the river, at the in the village, the syenite was found tain nepheline, and on tracing the band to a point about half a mile west rillage a little corundum was found in The mineral appears to occur very ly in the syenite in this vicinity.

g west from Bancroft the band of can be traced practically continuously ne distance. Drift deposits however re to some extent. The belt was fol- to lots 10 and 11 in A concession of y, and westward in the general direc- lowed by the Monk road. The syenite ppears to cross the road near a little n 16 A. A prominent exposure of shows on lot 19 A. About lot 23 A., fore coming to a bend in the road to st, nepheline syenite is exposed on the of the road. Syenite carrying nephe- sses the road at 26 A and B. The here is N. 70° W. Crystalline limestone in along the border of the white variety syenite. The whole band of syenite s a breadth of only 8 or 10 yards. nd of crystalline limestone which flanks he west has a breadth of two or three Pink syenite was found on or near in the fourteenth concession. This carries a quantity of magnetite in and has a considerable breadth. About n the same concession there is a well ed band of nepheline syenite which is 00 yards wide. It carries magnetite arse nepheline, and has a strike of . It runs up into a high hill and is posed. Following along the strike . from here for about one mile out- f nepheline syenite were seen in three places in a hardwood bush.

ı a hill on part of the belt of nepheline on lot 30 or 31 of the fourteenth con- a clearing can be seen on the Deer ad to the northwest. The belt of white could be seen in the distance keeping a direction of about N. 30° W. to within a very short distance of Deer Lake road, near the point where the outcrop which has already been referred to was observed in the vicinity of the junction of the three townships of Faraday, Cardiff and Herschel. This shows that the belt of syenite traced west from Bancroft through Faraday is continued, as has been stated by the writer, through the southwestern corner of Herschel, thence through Cardiff and around through Monmouth, keeping here pretty well the direction followed by the Irondale railroad, and into Glamorgan.

In the part of the band last referred to in Faraday the nepheline syenite is bordered by a band of pink syenite which carries magnetite, and is about one-quarter of a mile wide. The white syenite on lot 29, concession fourteen, carries considerable magnetite with a little pyrite, but nepheline is not strongly developed in it. It also contains some dark colored mica. The hills of syenite here are fully as high as the hills of other rock surrounding them. West of the syenite is a broad band of crystalline limestone.

County of Hastings.

Tracing the belt of Syenite Rocks eastward.

Having now traced the belt of syenite rocks from the township of Glamorgan in a general eastward direction through Monmouth, Cardiff, Herschel, and Faraday to the village of Bancroft on the Hastings road, which runs along the eastern side of Faraday and forms the boundary between this township and the township of Dungannon to the east, it is proposed to trace the belt eastward through this township and into adjoining townships, and to show the connection of this part of the belt with the belt of corundum bearing rocks which lies some distance to the northeast. This latter belt has a length of over 30 miles. A description of it was given in my report for 1897, and the map which accompanied the report showed the location of the belt.

Township of Dungannon.

Explorations along the York Branch.

It will be seen that corundum occurs much more frequently in the part of the belt which lies to the east and northeast of Bancroft than it does in the part lying to the west of this village. Moreover deposits of corundum will be described in the part of the belt now to be considered which are much richer in the mineral than are any of those lying to the west of the village. It may be stated that the whole belt of syenite and corundum-bearing rocks has a length of approximately 75 or 80 miles. About one-third of the belt lies to the west of Bancroft and the remaining two-thirds to the east and northeast of this village.

From Bancroft the syenite belt can be traced practically continuously through the township of Dungannon to the bridge across the York Branch river in the eleventh concession of the township. Some of the outcrops consist of very coarse grained rocks which contain a high percentage of nepheline. The syenite runs across the river above the bridge near the mouth of Egan's creek. On the east side of the river, near the bridge, the strike of the syenite is about north. Just north of the road, to the west of the bridge, there is an outcrop of coarse syenite carrying much nepheline and some sodalite. This outcrop was among the first of those discovered in the district by Dr. F. D. Adams, who collected specimens from the vicinity, and some of the material was subjected to examination by himself and Dr. B. J. Harrington.[3] No corundum was found in the vicinity however till 1898, when we found the mineral in syenite at points along the river's bank on both sides of this outcrop.

The part of the belt on the west side of the river crosses to the east at Egan's chute, which lies a short distance below the bridge to which reference has been made. Near the chute the belt, which is quite narrow here, is broken through by a hill composed of a rather dark igneous rock. On the other side of this hill nepheline syenite of similar character was again found in places and the belt was traced with various slight breaks up the eastern side of the York Branch river to a short distance below where Papineau creek enters this river in the tenth concession of the township of Carlow. Much of the syenite exposed along this part of the belt is rich in nepheline, and corundum was found in the rock at numerous places. Syenite also runs up the west side of the York river and outcrops show at intervals between the eleventh concession of Dungannon and the mouth of Papineau creek.

Features along the York Branch.

In Dungannon corundum was found near the centre of lot 18, in the eleventh concession. Some of the mineral is here light bluish gray, almost white, and it occurs in large sized pieces. The percentage of the mineral over the small surface examined here compares favourably with that seen in deposits in other parts of the district. Time did not permit of a careful examination of the lots immediately to the west, but from this lot to lot 13 in the same concession the rocks are covered to a considerable extent by drift and alluvial deposits and it is difficult to get exposures. On the north part of lot 13 there is a high hill composed essentially of granite which runs down into lower ground about half way across the lot towards the south.

On examining a map of the township of Dungannon it will be seen from the outcrops of syenite which have been referred to that the belt of this rock follows pretty closely the general direction in which the York Branch river runs.[4] Near Bancroft the strike of the rock in the belt is pretty well east and west. From this point the direction of strike swings around gradually conforming to the general direction of the course of the river, although not swerving at the smaller bends, till near the mouth of Egan's creek, and at the bridge on the eleventh concession the strike of the syenite belt and the direction of the course of the river are approximately north. The general course of the river from this point on for 12 or 15 miles to the mouth of Papineau creek is north, and the strike of the syenite band conforms to it. Near the mouth of Papineau creek the river makes its first great bend after leaving the bridge on the eleventh concession of Dungannon 12 or 15 miles below. This bend of the river is to the eastward, and the strike of the syenite changes again and conforms, as will be later described, to the course followed by the river.

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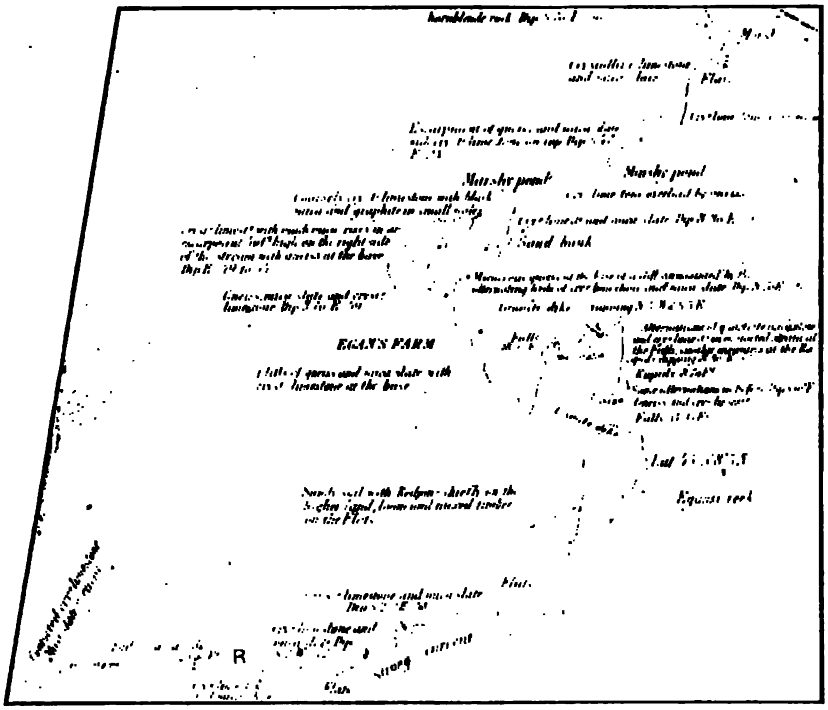
[3] Am. Journal of Science, July, 1894.

[4] The late Alexander Murray of the Canadian Geological Survey mapped the York river in 1853. A photographic reproduction of a part of his map with accompanying notes on the rocks along its banks accompanies this report (p. 211). The rock he calls mica slate is nepheline syenite, which in some cases possesses a well defined laminated structure and frequently carries corundum. What he calls hornblende rock is nepheline syenite with hornblende, and in some cases corundum and garnet. His quartzite is granite. Egan's farm is now known as Bronson's or Lancaster's.

As has been stated, the part of the syenite band on the west side of the river crosses to the east side at the first of the chutes which lies a short distance north or down the river from the bridge. Here on the east side of the chute the syenite is associated with some crystalline limestone, and a little north of the chute the narrow syenite belt is broken through by a hill of igneous rock which in the field was taken to be a diorite or gabbro. The syenite here is much more schistose in structure than the rock in the hill, and from this it was inferred to be the older of the two rocks. A little north of the hill considerable corundum was found in the rock. At the second chute, which lies a half mile or so down the river from the one to which reference has just been made, and below the sharp turn which the river makes after leaving the latter, syenite and crystalline limestone are seen at the edge of the rapids on the east side of the river. The limestone underlies the syenite and occurs at the water's edge. It has a strike somewhat east of north and dips eastward at an angle of about 40°. The channel of the river follows pretty well the direction of the limestone, apparently having been formed through this rock wearing away more readily than the o'her rocks with which it is associated. The limestone at the chute is graphite-holding. The bends in the river appear to be due to the fact that the limestone band has been disturbed or broken across by igneous masses. The river has not been able to cut its way through these so readily as through the limestone, and has hence been caused to swerve out of its course in places.



Part of York Branch (Shawashkong) River, after Murray, 1853.

Following down the east bank of the river, we found the syenite belt to be practically continuous. The rock is frequently very coarse in grain and contains a high percentage of nepheline. The belt keeps a pretty direct course and is thus at some points some distance from the river, as the latter has numerous bends. Towards the northeast corner of Dungannon we came to a large beaver meadow which breaks through the syenite belt and has its outlet in low land towards the river. The syenite runs up to the south edge of the meadow and outcrops again directly opposite, on the north edge. The syenite occurs in distinct ridges, which are frequently broken through by small ravines.

Crystals of Blue Corundum.

South of the beaver meadow referred to we found corundum of different colors. Some of this was of a deep blue and had a rather striking effect, some of the crystals standing well above the general surface of the rock, on account of the different rates of weathering of the two, and presenting a great contrast in color to the white of the rock.

Monteagle and Carlow.

A promising Deposit in Monteagle.

At the river bank and near the point where the corners of the three townships of Dungannon, Monteagle and Carlow come together we found an outcrop of nepheline syenite which showed on its weathered surface a high percentage of light colored corundum[5]. An old timber road comes down to the river just above the end of the ridge which rises into the hill on which the best outcrop occurs. The syenite, which, as stated, contains considerable corundum, was traced north here for about half a mile and was broken across at one point by a swampy wooded ravine. In addition to corundum the rock carries in places sodalite and white mica in flakes of considerable size. The rock here possesses a well defined schistose character, as does the syenite in many parts of the district. The corundum is light in color and the individuals of the mineral are of comparatively small size. Over a distance of some yards across the strike corundum is thickly scattered through the rock. Considering the situation of this deposit, its nearness to the water power at the Egan chutes, and the percentage of mineral carried by the rock, it appears to be one of the most promising in the district from the economic point of view.

The occurrence in this deposit of high percentages of both corundum and nepheline is somewhat exceptional, as usually where the percentage of one of these minerals is above the normal the other is either absent or only sparingly present.

Near the boundary between the townships of Monteagle and Carlow, and on the east side of the river to the northeast of Norway bay, there is an outcrop of pink syenite at the river's edge. Farther down the river and a little above the mouth of Papineau creek, rock of similar character outcrops again at the river's edge.

Below Papineau Creek in Carlow.

Just below the mouth of Papineau creek syenite is found on both banks of the York Branch river. The river near the mouth of Papineau creek, as has been previously stated, changes its course from northward to eastward. At the mouth of Papineau creek and for some distance to the east and north there is a tract of low, level, somewhat swampy ground, which is partly flooded at some seasons of the year. The outcrop of syenite at the edge of the York river just east of the mouth of Papineau creek comes up in this low land and is of small size. It can however be traced back from the edge of the river for some distance along a low, rocky ridge which rises through the alluvial deposits. On the south side of the York, opposite this outcrop, a more extensive development of the syenite is exposed, the belt here forming higher ground. It has a breadth of about 400 yards and is bounded on the west by crystalline limestone and on the east by crystalline limestone and gneiss. On both sides of the York here the rock has in places a high percentage of nepheline.

From the higher parts of the hills a tract of country of considerable size can be seen which is composed of the low land which has been referred to as lying north and east of the mouth of Papineau creek. This tract has the appearance of being surrounded by a range of high hills which seem to be arranged in a somewhat circular form. Some of these hills lie immediately to the west of Papineau

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[5] This outcrop is on lot 2 in the second concession of Monteagle.

Others .lie to the south and north- f the York Branch, and one of the t ranges of hills is that which runs he northeast to lot 14 in the fourteenth sion of Carlow. It was on this lot that lum was first found in the district. An it of the outcrop of rock which carries neral on this lot was given in my last report.

n the mouth of Papineau creek east- along the north parts of the lots in the tenth concession of Carlow, outcrops of syenite were found at a r of points. Foster's rapids on the Branch are situated on the southern lot 19 in the tenth concession. On rthern half of this lot and the adjoin- t 18 there is a hill which stands at a erable height above the surrounding The southern face of part of this hill down to the edge of Foster's clearing, the clearing near the foot of the hill l fairly large angular boulders of nephe- enite were found. These boulders lie he west side of the road which runs he main road into Foster's buildings. dum was found in place on the north f the hill. This part of the hill lies one-half mile to the southeast of the nd of Foster's lake, and near the ary between the tenth and eleventh sions. The rock here is basic in char- some of it having the appearance of enite. Nepheline occurs through some darkest of it.

r's

m the hill referred to a ridge more or ntinuous can be traced eastward along the northern part of the tenth concession to the point where the York Branch crosses the line be- the tenth and eleventh concessions at . The road which crosses the river f the rapid at Campbell's farm, lot 26, he line between the ninth and tenth sions, and runs northwestward towards Carlow, follows the low land to the of this ridge for some distance. On rth face of the ridge and near its foot, of a point on the road which is distant one-half mile from Campbell's bridge, line syenite was found in place. It here dips under crystalline limestone, which lies farther up the face of the ridge. The limestone is itself overlain by gneiss. Other outcrops of syenite would no doubt be exposed between this point and the outcrop on the hill north of Foster's, were it not for the covering of soil which overlies a great part of the surface. On part of the ridge a coarse gabbro-like rock is exposed. This may, as in other cases examined, be only a facies of the syenite rock.

n's

Eastward across the road the ridge runs out into a point which lies between two somewhat marshy bays of the York Branch. The bay on the north is known as Robinson lake. Syenite was found in place on this point on the northern face of the ridge.

Extension of the Syenite band Eastward.

The ridge is continued on the east side of the York Branch and was followed through marshy ground to near the edge of the Mississippi river. In this part of the ridge no syenite was found in place, but crystalline limestone was observed under conditions somewhat similar to those under which it is associated with syenite farther west on the ridge. The syenite occurs here in all probability in the low ground to the north of the foot of the ridge. Time did not permit us to attempt to follow the ridge east of the Mississippi in the tract of country lying between this river and the Madawaska, but it seems likely that outcrops of syenite do occur here and that this part of the belt runs eastward till it joins the main part of the belt of the corundum-bearing rocks in the northern part of the township of Lyndoch to the east. An examination of the map of the corundum belt which accompanied my report for 1897 will show that the part of the belt which runs down into Lyndoch is much wider and extends farther south than does that part of the belt which lies farther west in Raglan and Carlow. The narrow belt of syenite rocks which we traced in 1898 from near the mouth of Papineau creek, if continued eastward of the Mississippi and across the Madawaska, will strike the southern edge of the belt mapped in 1897 in Lyndoch.

The association of crystalline limestone with the nepheline syenite at points in the

Relations of Crystalline Limestone, Syenite and Granite.

tenth concession of Carlow has been referred to, as well as the frequent association of these rocks at various points along the York Branch between the mouth of Papineau creek and the bridge on the eleventh concession of Dungannon. Crystalline limestone also occurs at the eastern end of Foster's lake, lot 19 in the eleventh concession of Carlow, and at other places in the twelfth and thirteenth concessions of this township, as at Armstrong's mill site on Papineau creek, lot 6 in the thirteenth concession. This rock lies in a trough-like depression between the band of syenite in the tenth concession with the hills immediately south of the York Branch and the hills in the thirteenth, fourteenth and fifteenth concessions of the township. These last three concessions form part of the belt of corundum-bearing rocks which was mapped in the report of 1897. A great part of this trough has a covering of sand, and in addition to the crystalline limestone there are outcrops of granite, much of which is pegmatitic in character and which gradually rises into the hills in the thirteenth and fourteenth concessions. The outcrops of corundum-bearing syenite in the northern concessions of Carlow, as stated in last season's report, occur isolated. They cut through a dark gneiss and both the gneiss and the syenite are cut through by numerous pegmatites. Along the York Branch, as has been stated, the outcrops of syenite form a band which is practically continuous. It would thus seem that the outcrops of corundum-bearing syenite in the northern concessions of Carlow occur isolated owing to the fact that the gneiss through which they cut has not been worn down sufficiently to allow the band of syenite to be exposed continuously. [illegible] granite through it [illegible] difference in degree of denudation of the overlying dark gneiss and crystalline limestone. That some of the syenite has been subjected to strong metamorphic action is evident from the well developed schistose structure which it presents. The occurrence of two belts of syenite, one of which runs parallel with the tenth concession of Carlow and the other to the more northern concession of this township, is due to two causes, viz.: the overlying gneiss and limestone and the intrusion of granite of later age than the syenite. A structure of a similar kind was referred to on a preceding page in the description of the syenite rocks in the township of Methuen. In Methuen the syenite belt of the Blue mountains is separated from and runs parallel to a narrower belt which lies to the south of a trough which is filled with dark gneiss, together with some crystalline limestone and a little granite.

County of Renfrew.

Leaving Carlow behind we enter the county of Renfrew. With the exception of revisiting lots 1 to 4 in the eighteenth and nineteenth concessions of Raglan and examining the lots in the vicinity of Palmer's rapids we did not in 1898 re-examine other parts of the belt of corundum-bearing rocks which were traced through this township in 1897.

Township of Raglan.

Traces of Corundum west of Madawaska River.

In the report of 1897 reference was made to the occurrence of corundum on lot 19 in the eighteenth concession, and on two or three lots immediately to the east of the Madawaska along the line between the eighteenth and nineteenth concessions of Raglan. The high hill known as Indian Hill on lot 19 was re-examined last season, and in addition to the outcrops of corundum-bearing rocks which occur near the summit of the hill and towards its west face other outcrops of the rocks were found near the base of the hill on the western face. The outcrops near the summit of the hill contain garnet in places in association with the corundum, which is a somewhat rare association, having been found

w of the numerous outcrops examined
istrict.

the Indian hill on lot 19 the rock
raced through lot 20, there being an
of rock on this lot similar to some
which usually carries corundum.
k is a light colored syenite and con-
isiderable white mica. The side hill
the outcrop occurs (in which it may
no corundum was found) is pretty
ered by soil and trees. The outcrop
te being exposed by a recent fire
s destroyed the surrounding bushes
een for a considerable distance to the
t. From the foot of the hill on
his outcrop occurs a sand plain
out to the Madawaska, at the edge
, and in a line which runs in the
of the concessions from the last
ed outcrop, there is another small
of syenite. This exposure is situated
uth side of the river, at the head of
rapid known as the Horserace.
crop carries corundum and is situated
est side of lot 24 in the eighteenth
n. very close to the line between
nd 24.

the river from this outcrop and a
tance from the bank corundum again
the rock on lot 24 of the eighteenth
n. From this lot on to and includ-
3 corundum was found in a number
ps. These outcrops are situated on
h end of the lots in the eighteenth
n and on the south end of the lots
neteenth. An outcrop occurs at the
small swamp at the post where the
of the four lots 24 and 25 in the
th concession and 24 and 25 in the
th come together. The posts in the
nd on the edges of the concession
e found in place. Being situated in
nd they had escaped destruction by
which have burned over the district
he years which have elapsed since
eys were made. Very few of the
osts have escaped these fires.

east of lot 25 the chief outcrops of
n are on the south parts of lots 26,
3 in the nineteenth concession. The
hich the mineral occurs is for the
pink in color and coarse grained. Much of the corundum is coarse grained, agreeing in this with the rock in which it occurs.

A little east of the post which has been referred to as being situated at the point of contact of the four lots, and north of the concession line, there is an outcrop of nepheline syenite. This outcrop is at the edge of the small swamp mentioned. These occurrences of this variety of syenite are met with at intervals, as stated in last year's report, throughout the whole length of the belt running from Carlow on the west to Sebastopol on the east. The outcrop just referred to was not observed till last season. The nearest outcrop of similar character observed to the west is on lot 1 in the nineteenth concession of Raglan, and the nearest to the eastward is in the western part of Brudenell.

It will be noticed from the description given that the outcrops of corundum-bearing rocks across Raglan follow very closely the direction of the line between the eighteenth and nineteenth concessions, being sometimes just over the line on one side and sometimes on the other. Thus corundum occurs on the concession itself in the most western part of the township, as well as on the south parts of lots 1 to 4 in the nineteenth and on the north parts of 3 and 4 in the eighteenth. Then near where the concession line crosses the Madawaska the outcrops occur in the same relation to it, and others occur in the same situation as regards the line between these lots and the lots along the extreme western end of the line. Moreover, it was stated in last year's report that corundum-bearing rocks occurred sparingly on the north part of lot 35 in the eighteenth concession, this lot being the one the farthest east. The outcrops thus, from one side of the township to the other, have a rather remarkable arrangement in that they all follow so closely the direction of the concession line.

Radcliffe and Brudenell.

A small outcrop of corundum-bearing rock was also found near the edge of an old lumber road on lot 21 in the first concession of the township of Radcliffe. Other small outcrops also occur on one or two other lots immediately to the

A small Area parallel to the Main Belt.

northeast of this one. These may be said to form a small belt which has a direction roughly parallel to that of the main belt. It was stated in last year's report that the strike of the rocks changes near the western edge of the township of Brudenell and runs towards the northwest. This small isolated belt in Radcliffe serves to connect the outcrops near Palmer's rapids with those in the fifth, sixth and seventh concessions of Brudenell. These latter outcrops as shown on last year's map appeared to be somewhat disconnected from the part of the belt lying to the southwest. It may be stated that the corundum on lot 21 in the first concession of Radcliffe is associated with garnet similar to the outcrop referred to on lot 19 in the eighteenth concession of Raglan.

A number of large boulders rich in corundum were found on lot 19 in the sixteenth concession and on lots 18 and 19 of the fourteenth concession in Raglan. These boulders were no doubt carried southward by ice during the glacial period.

Sebastopol and South Algona.

Extension of the Belt into South Algona.

In last year's report it was stated that nepheline syenite boulders had been found in places thickly strewn along a line running east of north from the northeast corner of Lyndoch into the adjoining township of Sebastopol and across that part of the Opeongo road which lies to the west of lake Clear. A few were also found to the north of the lake. The position of these boulders was shown on the map, and it was stated that the outcrop from which they had been transported lay to the north. During last summer the outcrop was found in the first concession of the township of South Algona, which bounds Sebastopol on the north.

On lot 14 in the first concession of South Algona a number of nepheline syenite boulders were found and the rock was found in place on lot 11 of this concession. The syenite is here very coarse in grain, and the nepheline occurs in it in large sized pieces. The rock was also found in place across lots 8, 9 and 10 to the eastward and across 14, 15, 16 and 17 to the westward. The strike of the syenite here is about N. 75° E., magnetic. The band assumes the character of a series of dikes which cut a pinkish colored rock. They vary from one or two feet to 30 or 40 yards in width. The rock carries magnetite, some pieces of this mineral being a foot in diameter. The syenite is for the most part coarse in grain and somewhat porous. No corundum was found in place here, but some boulders carrying the mineral were found a short distance south of the outcrop.

The direction followed by the glacial striæ in this part of the field is N. 15 E. magnetic. Had time permitted no doubt other outcrops of syenite could have been found farther eastward.

Nepheline Syenite in Sebastopol.

In the southernmost part of Sebastopol a number of outcrops of nepheline syenite were found. In the first concession a band of this rock was traced through lots 13 to 5 inclusive. On lot 6 the band is at least 300 yards wide, but tapers towards the east and west. Closely associated with the syenite are more basic rocks. The band is flanked on both sides by crystalline limestone. The band was traced from the west end of Highland lake, lot 12 in the first concession, to the south end of lot 5 and appears to run into Griffith on the south. It crosses Highland creek at Lambert's mill. The strike of the rock is northeast.

Nepheline syenite boulders were found alongside of the road on lot 4 in the fifteenth concession of Denbigh.

Along the Snow Road.

Westward on the Snow Road.

The road from lot 3 in the thirteenth concession of Denbigh follows Hyde's creek to the vicinity of Denbigh village. The creek is quite rapid in places. From the village to the Snow road crossing is a distance of about three miles. The rock here exposed is gneiss, associated with which there is a narrow band of crystalline limestone which outcrops about one-quarter of a mile from the crossing.

Following the Snow road westward from the crossing an area of gray or white granite with a width along the road of 12 or 15 miles comes in. The eastern boundary of this area is near the line between Denbigh and Ashby, and the western boundary in the latter township is not far from the edge of Mayo. The rock is very uniform in character. That the area occupied by it is unsuited for cultivation is evident from the fact that for about 12 miles along the road, through what is known as the "long bush." there are no settlers. Rock of similar character is exposed some miles to the northeast of Griffith's, north of the Madawaska river.

The road in Ashby runs between Otter and Weslemkoon lakes, where the granite is well exposed.

Proceeding westward through Mayo, from the edge of the granite area, the rocks exposed are gneiss and crystalline limestone.

From Mayo the road proceeds westward through Dungannon, and crosses the York river at the bridge in the eleventh concession to which reference has been made.

Lanark and Frontenac.

Corundum discovered in South Sherbrooke.

Corundum was found in place in the township of South Sherbrooke, Lanark county, by Mr. L. J. Gemmell of Perth, in September, 1898. Mr. Gemmell had been in attendance on the prospectors' course at the Kingston School of Mining during January and February, 1898, and while there had had his attention directed to corundum, which was being experimented on at the time at the School. He had learned something of the character of the mineral and of its mode of occurrence, and on going into the field in the following season had decided to look for it. On meeting Mr. Morrow, a resident of the township referred to, a gentleman who has paid considerable attention to the minerals of his district, Mr. Gemmell described to him how corundum occurs in the rocks, laying special stress on the fact that the mineral usually stands well above the weathered surface of the mass in which it is found. Mr. Morrow at once stated that some years before he had observed crystals of mineral attached to the surface of a rock in the sixth concession of South Sherbrooke. The two gentlemen visited the locality together and found a mineral occurring as Mr. Morrow had described it. They were in doubt however as to whether it was corundum, on account of its being almost white in color and thus differing from the specimens Mr. Gemmell had seen in Kingston. However, to make sure of the point, they sent specimens to Prof. Nicol of the School of Mining, who assured them that it was corundum without a doubt.

Immediately after the "find" had been verified Mr. Gemmell invited the writer to visit the locality, in order that a comparison might be drawn as regards the richness of these deposits in Lanark with those situated in North Hastings and adjoining areas fifty miles or so to the northwest. A visit was accordingly made to South Sherbrooke in October, after the completion of the field work which has been described in preceding pages. It was found that the corundum occurs in a belt of igneous rocks which has a strike about parallel to that of the concession lines of the township. This is N. 45° E., astronomical. This belt, so far as examined in the township, lies wholly in the sixth concession and has been traced from lot 12 to lot 1, the latter lot lying at the boundary between this township and Oso to the west. The breadth of the belt is about three-quarters of a mile. The belt also extends into Oso, keeping the same direction.

Size and color of the Crystals.

The largest crystals of corundum observed in the rock had a length of about 1¼ inches, but are thick and more tabular in form than most of those found in North Hastings and adjacent country. The majority of the crystals have a diameter of about half an inch and show a rather striking uniformity in size, there being scarcely any of the mineral in small grains. The color of the mineral is also pretty uniform, being light gray or almost white, and sometimes light pink or flesh colored. It may also be stated that the corundum is distributed across the whole breadth of the band of rocks but in no place examined was the percentage high, the richest parts of the rocks averaging probably about five per cent. The crystals stand well out on the weathered surface of the rock and are often attached to it by a very small part of their under surface.

[illegible]

[illegible] position [illegible] anorthosite [illegible] from the [illegible]

[illegible]

[illegible] appearance [illegible] from Eastern

[illegible] thus de- [illegible] granular [illegible] near Ottawa. [illegible] the specimen [illegible] named by [illegible] and made [illegible] and a white [illegible] which are some- [illegible] beautifully striated." [illegible]

[illegible] labradorite [illegible] the essential con- [illegible] anorthosites. It [illegible] the fact that few analyses [illegible] Moreover, it may be said [illegible] areas have been ex- [illegible] analyses and those of other [illegible] were on samples from the [illegible] adjacent to the St. Lawrence [illegible] adjoining region in the United States [illegible] assumption that labradorite is the [illegible] rocks may moreover be due to [illegible] the areas of anorthosite to which [illegible] are of large size, and thus [illegible] would on the whole be more [illegible] outcrops. From the analyses [illegible] by the present writer [illegible] it would seem that no one plagioclase [illegible] typical constituent of these rocks.

[illegible] der Gesteinslehre, pages [illegible] and [illegible] analyses of anorthosites; Kemp, Hamil- [illegible] and Adams' (N. J. [illegible] Min. [illegible] These range in percentage of silica [illegible]

Ontario albite anorthosites also occur associated with the corundum-bearing group.

	I. Seine River.	II. South Sherbrooke.	III. Rawdon, Que.
SiO_2	46.24	47.32	54.45
Al_2O_3	29.85	30.36	28.05
Fe_2O_3	1.30	1.35	0.45
FeO..........	2.12	1.55	.....
MnO.........	trace	.....	.....
CaO	16.24	15.45	9.68
MgO.........	2.41	2.44	.....
Na_2O	1.98	1.88	6.25
K_2O.........	0.18	0 66	1.06
CO_2	1.03	0.58	.....
H_2O	.....	0.10	0.55
Total	101.35	101.69	100.49
Sp. Gravity ..	2.85	2.73	2.69

The following analyses, made by Mr. Lawson, show the composition of the two constituents of the South Sherbrooke anorthosite. For comparison the theoretical composition of a plagioclase, $Ab_1 An_4$, quoted by Zirkel[7], is given, as well as the composition of a hornblende from hornblende gabbro quoted by Rosenbush[8].

	Bytownite.		Hornblende.	
	I.	II.	III.	IV.
SiO_2	48.12	48.03	41.40	39.58
TiO_2	....	....	....	trace
Al_2O_3	34.54	33.43	15.39	14.91
Fe_2O_3	0.36	....	7.01	4.01
FeO	....	....	7.17	10.67
MnO..........	....	....	trace	trace
CaO	16.30	16.28	12.53	11.76
MgO..........	trace	....	10.31	13.06
K_2O...... ..	0.15	....	1.56	0.62
Na_2O	1.91	2.26	3.58	2.87
H_2O...... .. (ignition)	none	....	0.81	2.79
	101.38	100.00	99.76	100.27
Spa. Gravity ..	2.731	2.735	3.188 at 15° C	3217—322^2

I. Bytownite from the Anorthosite of South Sherbrooke, Ont.

II. Bytownite, $Ab_1 An_4$, given by Zirkel.

III. Hornblende from the Anorthosite of South Sherbrooke.

IV. Hornblende from a Hornblende Gabbro, quoted by Rosenbusch.

It will be seen that there is a remarkably close agreement between the theoretical composition of bytownite, $Ab_1 An_4$, as regards the percentages of the silica, lime and alkalies and that of the felspar from the South Sherbrooke rock. The proportion of alumina in the latter is however over one per cent. higher than that of the theoretical percentage. This may be due to the presence of a small amount of corundum embedded in the felspar in a very fine state of division, as this mineral occurs, as has been stated, in parts ot the rock. None of it was identified however, either by megascopic or microscopic examination, in the specimen analyzed. In thin sections under the microscope the felspar is seen to contain numerous crystallite-like inclusions It is possible that some of these are corundum.

The hornblendic constituent of the anorthosite is seen by the analysis to have the composition of the typical variety, or what is called common hornblende.

Oso in Frontenac County.

Westward Extension of the Belt.

From the boundary of the township of South Sherbrooke the belt of corundum-bearing anorthosite runs westward into the adjoining township of Oso in Frontenac county. During the little time I spent in this township however I did not succeed in finding the belt so well defined as in South Sherbrooke, although corundum was found in the rock in situ at two or three places and anorthosite boulders carrying corundum were found lying south of a line which runs several miles to the west, thus showing that the belt continues for a considerable distance across country.

As only a hurried walk was made through this part of the township the location of the outcrops of rock and the distribution of the corundum-bearing glacial boulders can be only approximately stated. This is owing also in some measure to the fact that some of the streams and small lakes were found to be incorrectly laid down on the township map. In a general way it may be said that the belt of corundum-bearing anorthosite enters Oso near the northern edge of Rock lake, which lies at the boundary of the townships of South Sherbrooke and Oso. This is near lots nine or ten in the seventh and eighth concessions. From this point the belt, judging from the position occupied by the glacial boulders, runs southwestward about midway between the southern edge of Sharbot lake and the northern extremity of Crow bay, which is an extension of Bobb's lake. No clearly defined belt was found here, but considerable rock in place resembled that farther east, and this rock crosses the Kingston and Pembroke railway a short distance south of Olden station. Just east of the railway track the rock was found to be associated with crystalline limestone. At the side of a spring which has been fitted up with a curb, and which is situated just over the fence on the east side of the track near some farm buildings, there is a boulder which carries the characteristic light colored corundum of the district. A little to the southeast of these buildings and along the wagon road to the east numerous similar boulders occur, scattered over the surface of the ground. Down the track a mile or more south of Olden station other boulders which carry corundum occur. All the boulders referred to are rather dark in color on weathered surfaces, but have a somewhat characteristic appearance, due to a bluish or purplish shade of color, which can be made out when some distance from them, and thus serves to distinguish them from the boulders of "trap" and other dark colored varieties of rock which are associated with them.

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[7] Petrographie, 2nd edition, page 221.

[8] Elemente der Gesteinslehre, page 148^1

Around Eagle lake

West of the railway track the belt runs towards the north end of Eagle lake, of which the greater part lies in the north-east corner of the township of Hinchinbrooke. A boulder carrying corundum was found at the roadside about one mile north of the village of Parham, which is situated at the south end of the lake. As none of the rock was found in place around the north shore of the lake, it would appear that the belt runs through the lake or along its southern edge. The rock may be in place on some of the islands of the lake, which time did not permit me to examine. This belt is likely continued to the south-westward of Eagle lake [illegible] corundum [illegible] will likely be found in place [illegible] examination be made [illegible]

[illegible] Gabbro Area

[illegible] Kingston and Pembroke [illegible]

Other minerals in the Gabbro

to the gabbro family. The chief constituents of the rock are basic plagioclase and pyroxene. The pyroxene consists in some specimens of both diallage and hypersthene, so that it would be as proper to call the rock a norite as a gabbro. Both the diallage and the hypersthene contain the inclusions characteristic of these minerals. The inclusions here are however striking on account of their comparatively large size, and have been referred to in a paper published some three years ago.[10]

Other minerals occurring in subordinate amounts in this gabbro are biotite, apatite, magnetite and pyrite, besides other accessory constituents of less prominence. Stringers of quartz of secondary origin are also sometimes present. An interesting fact in connection with part of the gabbro is that some of the basic plagioclase on microscopic examination is found to be altering into scapolite, as shown in Fig. 3. This mass then represents a stage in the alteration of gabbro into the scapolite rocks which are so characteristic of some parts of the region under consideration. In the typical scapolite rocks the essential constituents are scapolite and secondary hornblende. The former mineral as stated is believed to come from plagioclase, and the latter appears to be derived from pyroxene by alteration. In some varieties of the scapolite rocks, which will be hereafter referred to in speaking of some of the corundum deposits, none of the plagioclase or pyroxene remains unaltered.

Part of the gabbro mass just north of Parham station lies to the east of the railway track and part of it extends westward to near the shore of Eagle lake.

The phosphate deposit known as the Boyd Smith or Eagle lake property lies at the edge of the mass and near the shore of Eagle lake. This deposit has been described in the Report of the Royal Commission on the Mineral Resources of Ontario, 1890. While most of the phosphate has been mined at the edge of the gabbro mass, still some outcrops of the mineral are surrounded by the gabbro.

[illegible] corundum [illegible] in the township of Hinchinbrooke.

[10] W. G. Miller and R. W. Brock, Canadian Record of Science, [illegible]

with no other rocks intervening. A considerable amount of titaniferous magnetite also occurs on this property in the gabbro, and some of the ore has been blasted out. This magnetite, like other titaniferous varieties, carries a small amount of nickel and cobalt.[11]

One specimen was found to contain 0.1974 per cent. of the metals. A fine grained variety from the same deposit was found to contain 0.5648 per cent. of nickel and 0.2622 per cent of cobalt. Samples of pyrite in association with the gabbro on the same property gave 1.6785 per cent. of nickel and 0.9847 per cent. of cobalt. All these analyses were made by Mr. F. J. Pope, M. A., late demonstrator in the Kingston School of Mining.

Scapolite Rocks.

As has been stated, some of the basic plagioclase in the Parham gabbro mass can be seen, when the rock is examined in thin sections under the microscope, to be more or less altered into scapolite. There are other large masses of the rock in the district in which the plagioclase appears to have been completely altered into scapolite and the pyroxene into hornblende. Again there are masses of gabbro-like rocks intermediate in mineralogical composition between the Parham mass and these masses in which the felspar is represented entirely by scapolite. Many of these scapolite-bearing rocks are found in association with iron ore deposits. Very often the scapolite rock forms one wall of the ore body while the other wall consists of usually somewhat impure crystalline limestone. A deposit of this character is that known as the Glendower mine, near Bedford station on the K. & P. railway. Here the foot wall of the deposit is a scapolite rock which in the field has the general appearance of a somewhat coarse gabbro, but when examined in thin sections under the microscope the light colored constituent is seen to consist almost entirely of scapolite, with some calcite, while the dark constituent is hornblende. See Fig. 4.

Scapolite associated with Iron Ores.

The scapolite rock is much freer from oxides of iron than is ordinary gabbro, and it would seem as if in the process of alteration of the gabbro, now represented by the scapolite rock, the iron oxides had been leached out and deposited from solution, thus giving rise to the iron ore body.

In his description of the corundum district of Burma Prof. J. W. Judd[12] states: "The study of the Burma limestones leads to the conclusion that the basic gneisses may undergo a corresponding metamorphosis, the breaking up of the lime-felspar leading to the formation of an unstable scapolite, from which and from other unstable minerals originate, as a consequence of further change, the calcite and dolomite." It may be added that in Eastern Ontario it is possible that some of the crystalline limestones which are so intimately associated with scapolite rocks, which latter are alteration products of igneous rocks, may represent the extreme forms of the alteration of these igneous rocks.

The scapolite rock from the Robertsville mine, which forms one of the walls of the magnetite deposit, in mineralogical composition stands between the Parham gabbro and the scapolite rock of the Glendower mine. I consists essentially of scapolite, plagioclase, both of which occur in large amounts, and hornblende. The microscopical characters of this rock were described some years ago by Dr. F. D. Adams and Dr. A. C. Lawson.[13]

Corundum in other Countries.

Recent Reports by Foreign Authors.

In last year's report, p. 213, a brief account was given of the modes of occurrence of corundum and emery in different countries. Since the publication of that report two important monographs have appeared on the subject. For a copy of one of these I am indebted to Dr. T. L. Walker of Calcutta. This valuable report on the corundum deposits of India, consisting of 79 pages, is by Mr. T. H. Holland.[13] The other publication referred to is by Josef Morozewicz, and deals with the artificial production of corundum and other minerals in magmas.[14] A brief account is also given of the modes of occurrence of corundum in Russia. The volume consists of reprints of articles from an Austrian periodical, and I am indebted to the kindness of the author for a copy of it.

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[11] Seventh Report Bureau of Mines, pp. 230 to 232.

[12] The Rubies of Burma and Associated Minerals. Phil. Trans. Roy Soc. London, vol. 187, p. 205.

[13] Can. Rec. Science, 1889, page 198.

[13] A Manual of the Geology of India, Economic Geology part I, Corundum by T. H. Holland, A.R.C.S., F.G.S., Deputy Superintendent Geological Survey of India, 1898.

In India.

As corundum occurs under many forms in India, and some of its modes of occurrence there are similar to those under which the mineral occurs in Ontario, it seems advisable to give a brief review of Mr. Holland's paper in this report.

The home of corundum.

In the introduction to his report Mr. Holland states that "The Indian Empire can with very good reason be claimed as the home of corundum. The name corundum under which the dull coloured and non transparent forms of natural alumina have generally been known since the introduction into Europe of a large number of Indian specimens towards the end of the last century is only a modified form of the Sanskrit word kurand. Not only are there large deposits in India of the common form of the mineral, but the most highly prized specimens of the transparent red variety, the ruby, have been obtained from the [illegible] of Burma, whilst the [illegible] of Kashmir [illegible] noted for the size and [illegible]

Mr. Holland [illegible]

[illegible]

[illegible]

varieties. It is stated that the ruby and sapphire, known as "perfect corundum," were prized by the ancients "for their beauty and supposed efficacy in medicine or magic." A quotation is given from an ancient author by whom the mineral is called hyacinthus. "This is the gem that feels the influence of the air and sympathizes with the heavens, and does not shine equally if the sky be cloudy or bright. Besides, when put in the mouth it is colder than other stones. For engraving upon indeed it is by no means adapted, inasmuch as it defies all grinding; it is not however altogether invincible, since it is engraved upon and cut into shape by means of the diamond." Even at the present time, Mr. Holland states, the mineral is thought by the natives to have a medicinal value. "Like many minerals common corundum is used in India for medicinal purposes. The hakims (native doctors) of the Punjab use calcined corundum as a cooling medicine in fevers (dose about 16 grains). They also apply it to wounds to stop bleeding." In fact mythical properties innumerable seem to have been attributed to the common and gem varieties of the mineral. Rubies of certain quality were believed to concern the life, death, wealth, poverty, success, failure, humiliation, exaltation of their owners. Stones of certain character were believed to subject their possessors to lightning strokes, to blows from a weapon, or to loss of domestic animals. To the sapphire among other properties was attributed the power of extinguishing fire, and of curing fever, inflammation and evil passions. It may be added that this belief in the supernatural powers of gems and other mineral objects is not confined to eastern nations. Even among ourselves at the end of the nineteenth century there are some who consider it ill luck to possess or wear certain gem stones, and everyone has heard of men who carry horse chestnuts in their pockets or wear rings as a preventative of rheumatism.

Mr. Holland states [illegible] that "There [illegible] with corundum. [illegible] occurring as a rock constituent [illegible] varieties are different [illegible] than that generally applied to her simple oxides occurring in a pre- similar manner." This agrees with inion expressed by the present writer t year's report. Mr. Holland further that until recently the known occur- s of corundum in situ were few, and ay account for the tendency there has o regard the origin of corundum as due usual or secondary circumstances, its ction having been thought to be due to ction of mineralizing agents or other s affecting the aluminous rocks in which urs. "The principal Indian occurrences undum in situ can be divided into two s: (1) Those in which corundum is asso- with basic rocks, and (2) those in which sociates are distinctly siliceous (acid). classes are well represented in India, most cases where corundum has been associated with basic rocks intrusions gmatite have also been found in the bourhood." The basic rocks have pyr- as a predominant constituent. With e associated hercynite, ruby, spinel, aste, magnetite, ilmenite, corundum and minerals. Corundum also occurs in lline limestones, and it has been shown these limestones are intimately asso- l with pegmatite, this association of the being a constant feature of the Madras dum deposits. In view of Prof. Judd's sions these limestones are regarded as extreme forms of the alteration of rocks which are now generally led as igneous in origin. "It seems priate to link with them (the limestones) northite rock containing corundum in alem district of Madras. Although the hite matrix was the first described gst the occurrences of corundum, this ation appears to be rare, possibly be- the anorthite has in many cases been ed to carbonate of lime."

udd's
ions.

connection with the Ontario occurrences rundum the fact has been mentioned that corundum has been found in a basic anorthosite, a rock very similar in character to the corun- bearing anorthite of India No occur- s in this Province are however known resemble those of India in which corundum is found in highly pyroxenic rocks, or in their altered representative the crystalline limestone. Attention has been drawn however, both in the present report and that of last year, to the frequent association of quartziferous pegmatite with the corundum-bearing rocks of the Province. It has also been stated that the corundum-bearing rocks of Ontario are, in the majority of cases examined, closely associated with crystalline limestones.

ison
ntario
nces.

"The sapphires of Kashmir occurring in a granite, form a good example of the occurrence of corundum in rocks of acid composition."

In Ontario corundum has not been observed in granite, but the more acidic varieties of syenite which contain the mineral appear, as has been stated, to pass into granite in some cases.

Burma.

Rubies in
Crystalline
Limestone.

In Burma, which is celebrated for its rubies, the principal mines are those in which the stones are found in crystalline limestone, hill-wash, or in alluvium. In one small area in Upper Burma there are ten distinct bands of crystalline limestone in a distance at right angles to their strike of 2½ miles. Their collective thickness across their outcrops is about 2,670 feet. The gem stones are obtained by washing the detrital matter produced by the weathering down of the limestone. "The limestone itself has also been quarried for the rubies occurring in situ, but the shocks produced by blasting and subsequent hammering of the rocks invariably injure numbers of the gem-stones." At one point in the Coimbatore district "two rocks of different composition and structure are connected with the appearance of corundum . . . The one is the pale gray elæolite syenite of the Sivamalai Hill, and the other a coarse felspar-rock intruded as veins into the former rock." The latter rock is composed of red or deep flesh-colored plagioclase and biotite in large nests of small plates. It is in this rock that the corundum occurs, and it appears to be an original constituent of the rock. Although

Unique occurrence of Corundum in nepheline syenite in Ontario.

corundum occurs in a rock here which is associated with elæolite or nepheline syenite, the mineral has apparently not been found occurring in the latter rock in India. The same appears to be true of all other countries, including particularly the Ural mountain district of Russia and other districts in which both corundum and elæolite syenite occur. Judging from the descriptions of the occurrences of corundum in these countries which have so far been published, Ontario is the only country in which corundum has been observed to occur in elæolite (nepheline syenite). In this Province numerous occurences have been observed by the present writer in which the mineral is embedded in syenite of this character.

In the Salem district corundum occurs under conditions very similar to those which have been stated by the present writer to prevail in the deposits of this mineral in the township of South Sherbrooke. Mr. Holland describes the rock as "consisting of anorthite (indianite) and hornblende chiefly." The specific gravity of a specimen with but little hornblende was found to be 2.824. The corundum is of a "pale, greenish-gray, rarely flesh colour, and occurs sparsely distributed" among the parts of the rock which has a gneissoid structure, which are richer in anorthite. "It takes the form of irregular lumps averaging from one-quarter to one inch in diameter. The crystals do not, as a rule, show the prismatic and pyramidal faces . . ."

This description of the mineralogical composition of the rock and the form and color of the contained corundum applies very well to the occurrence in South Sherbrooke.

In the Salem district, as in the other corundum areas of India, one of the characteristic features is the occurrence of dikes of coarse granite or pegmatite, and reference is also made to the occurrence in this district of dikes of a dark compact trap, both of which rocks are frequently found in the neighbourhood of the Ontario corundum deposits.

Paparapatti Area.

Working rock Corundum for Abrasive purposes.

In the Paparapatti area corundum occurs in the solid rock, and since this is one of the few localities in India in which att have been made to work deposits in order to extract th eral for abrasive purposes it n well to give Mr. Holland's de tion of the occurrence, with his concl as to the economic value of the de This will be of some assistance in estin the relative importance of the Ontari posits

"The actual matrix of the corund this area occurs as bands of lenticular m of principally deep flesh-colored orth (finely crystalline, and showing und microscope a fine microperthitic or c perthitic inter-growth of possibly plagic in which there is often a considerable p tion of sillimanite (fibrolite), rutile, o black and green spinel, with biotite, last is especially developed at the peri of each lenticle. The size of these le is sometimes as much as fifteen feet lo eight feet across where actually seen rock. The corundum here differs enti appearance from that of Sittampundi. of a deep purplish brown or sometime greenish-gray colour, and is always re crystallized into hexagonal prisms great number of variously inclined pyr faces imperfectly developed, and so the prism an elongated barrel or even s shape.

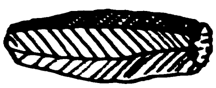

Fig 3. Crystal of Corundum showing the cu faces due to alternation of the prism and pyrami well as traces of the rhombohedral parting pl Paparapatti area, Salem district. Natural size (Holland).

"In size they vary from extremely grains and crystals only visible in a scopic section, to large crystals several long and from one-fourth to one inch i meter. The characteristic parting parallel to the rhombohedron are easily manifest by breaking the crystals, and times traces of these planes are visible prism faces (Fig 3). Occasionally also ternation of the rhombohedron and pris be seen in a single crystal. Each cry surrounded by a shell of purer orth

Rapids above High Falls, York Branch River. —W. K. George.

High Falls on York Branch River, from a point above the Falls. W. K. George.

theast of this one. These may be said to m a small belt which has a direction ighly parallel to that of the main belt. It s stated in last year's report that the strike the rocks changes near the western edge the township of Brudenell and runs towards he northwest. This small isolated belt in Radcliffe serves to connect the outcrops near Palmer's rapids with those in the fifth, sixth and seventh concessions of Brudenell. These latter outcrops as shown on last year's map appeared to be somewhat disconnected from the part of the belt lying to the southwest It may be stated that the corundum on lot 21 in the first concession of Radcliffe is associated with garnet similar to the outcrop referred to on lot 19 in the eighteenth concession of Raglan.

A number of large boulders rich in corundum were found on lot 19 in the sixteenth concession and on lots 18 and 19 of the fourteenth concession in Raglan. These boulders were no doubt carried southward by ice during the glacial period.

Sebastopol and South Algona.

Extension of the Belt into South Algona.

In last year's report it was stated that nepheline syenite boulders had been found in places thickly strewn along a line running east of north from the northeast corner of Lyndoch into the adjoining township of Sebastopol and across that part of the Opeongo road which lies to the west of lake Clear. A few were also found to the north of the lake. The position of these boulders was shown on the map, and it was stated that the outcrop from which they had been transported lay to the north. During last summer the outcrop was found in the first concession of the township of South Algona, which bounds Sebastopol on the north.

On lot 14 in the first concession of South Algona a number of nepheline syenite boulders were found and the rock was found in place on lot 11 of this concession. The syenite is here very coarse in grain, and the nepheline occurs in it in large sized pieces. The rock was also found in place across lots 8, 9 and 10 to the eastward and across 14, 15, 16 and 17 to the westward. The strike of the syenite here is about N. 75° E., magnetic. The band assumes the character of a series of dikes which cut a pinkish colored rock. They vary from one or two feet to 30 or 40 yards in width. The rock carries magnetite, some pieces of this mineral being a foot in diameter. The syenite is for the most part coarse in grain and somewhat porous. No corundum was found in place here, but some boulders carrying the mineral were found a short distance south of the outcrop.

The direction followed by the glacial striæ in this part of the field is N. 15 E. magnetic. Had time permitted no doubt other outcrops of syenite could have been found farther eastward.

Nepheline Syenite in Sebastopol.

In the southernmost part of Sebastopol a number of outcrops of nepheline syenite were found. In the first concession a band of this rock was traced through lots 13 to 5 inclusive. On lot 6 the band is at least 300 yards wide, but tapers towards the east and west. Closely associated with the syenite are more basic rocks. The band is flanked on both sides by crystalline limestone. The band was traced from the west end of Highland lake, lot 12 in the first concession, to the south end of lot 5 and appears to run into Griffith on the south. It crosses Highland creek at Lambert's mill. The strike of the rock is northeast.

Nepheline syenite boulders were found alongside of the road on lot 4 in the fifteenth concession of Denbigh.

Along the Snow Road.

Westward on the Snow Road.

The road from lot 3 in the thirteenth concession of Denbigh follows Hyde's creek to the vicinity of Denbigh village. The creek is quite rapid in places. From the village to the Snow road crossing is a distance of about three miles. The rock here exposed is gneiss, associated with which there is a narrow band of crystalline limestone which outcrops about one-quarter of a mile from the crossing.

Following the Snow road westward from the crossing an area of gray or white granite with a width along the road of 12 or 15 miles comes in. The eastern boundary of this area is near the line between Denbigh and Ashby,

he western boundary in the latter town-
s not far from the edge of Mayo. The
is very uniform in character. That the
occupied by it is unsuited for cultivation
ident from the fact that for about 12
along the road, through what is known
e "long bush" there are no settlers.
of similar character is exposed some
to the northeast of Griffith's, north of
[adawaska river.

road in Ashby runs between Otter and
mkoon lakes, where the granite is well
ed.

oceeding westward through Mayo, from
lge of the granite area, the rocks exposed
neiss and crystalline limestone.

om Mayo the road proceeds westward
gh Dungannon, and crosses the York
at the bridge in the eleventh concession
ich reference has been made.

Lanark and Frontenac.

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ed
oke.

undum was found in place in the town-
of South Sherbrooke, Lanark county, by
Mr. L. J. Gemmell of Perth, in
September, 1898. Mr. Gemmell
had been in attendance on the pros-
pectors' course at the Kingston
l of Mining during January and Febru-
898, and while there had had his atten-
irected to corundum, which was being
imented on at the time at the School.
d learned something of the character
mineral and of its mode of occurrence,
n going into the field in the following
had decided to look for it. On meet-
[r. Morrow, a resident of the township
ed to, a gentleman who has paid con-
ble attention to the minerals of his dis-
Mr. Gemmell described to him how
dum occurs in the rocks, laying special
on the fact that the mineral usually
well above the weathered surface of the
n which it is found. Mr. Morrow at once
that some years before he had observ-
stals of mineral attached to the surface
rock in the sixth concession of South
rooke. The two gentlemen visited the
y together and found a mineral occur-
s Mr. Morrow had described it. They were in doubt however as to whether it was corundum, on account of its being almost white in color and thus differing from the specimens Mr. Gemmell had seen in Kingston. However, to make sure of the point, they sent specimens to Prof. Nicol of the School of Mining, who assured them that it was corundum without a doubt.

Immediately after the "find" had been verified Mr. Gemmell invited the writer to visit the locality, in order that a comparison might be drawn as regards the richness of these deposits in Lanark with those situated in North Hastings and adjoining areas fifty miles or so to the northwest. A visit was accordingly made to South Sherbrooke in October, after the completion of the field work which has been described in preceding pages. It was found that the corundum occurs in a belt of igneous rocks which has a strike about parallel to that of the concession lines of the township. This is N. 45° E., astronomical. This belt, so far as examined in the township, lies wholly in the sixth concession and has been traced from lot 12 to lot 1, the latter lot lying at the boundary between this township and Oso to the west. The breadth of the belt is about three-quarters of a mile. The belt also extends into Oso, keeping the same direction.

Size and color of the Crystals.

The largest crystals of corundum observed in the rock had a length of about 1¼ inches, but are thick and more tabular in form than most of those found in North Hastings and adjacent country. The majority of the crystals have a diameter of about half an inch and show a rather striking uniformity in size, there being scarcely any of the mineral in small grains. The color of the mineral is also pretty uniform, being light gray or almost white, and sometimes light pink or flesh colored. It may also be stated that the corundum is distributed across the whole breadth of the band of rocks but in no place examined was the percentage high, the richest parts of the rocks averaging probably about five per cent. The crystals stand well out on the weathered surface of the rock and are often attached to it by a very small part of their under surface.

Corundum-bearing Anorthosite.

Characteristics of the rock.

Thin sections were made of specimens of the rock, and on examining these under the microscope they were found to consist largely of a basic plagioclase felspar together with some green hornblende. Mr. William Lawson, B.A.Sc., kindly made a chemical examination of the rock for me. He also analyzed the plagioclase and hornblende after they had been separated from the powdered rock mass by means of a heavy solution. On analysis the rock proved to be anorthosite, but of a more basic character than the typical varieties of this rock on which much work has been done by officers of the Canadian Geological Survey and others. The felspar in the South Sherbrooke rock was found to be bytownite with the formula Ab_1An_4, while the felspar in the normal anorthosites is more acid in character, being typically labradorite.

Classification of Anorthosites.

The only anorthosite or plagioclase felspar rock the writer has seen described which agrees in composition with this South Sherbrooke rock is one from Seine river in northwestern Ontario. This rock was described by Dr. A. P. Coleman some years ago.[6] Dr. Coleman says of this rock: "The results of the analysis show that the anorthosite from the mouth of the Seine is one of the most basic of the massive rocks, and it is possible that the low silica contents and the fact that it consists essentially of anorthite instead of labradorite would justify a separation under a distinctive name; but there seems little doubt that numerous intermediate rocks, such as that from Bad Vermillion, link it to the typical anorthosite of the Province of Quebec. On the whole it will be wiser not to add another name to the rapidly growing burden of the lithologist; for it is clear that these rocks are not definite species, but shade into each other just as the plagioclase felspars do. Possibly a binomial nomenclature like that tacitly admitted in the classification of other rocks, such as the granites, might be adopted, the typical anorthosite being called labradorite anorthosite, that from Bad Vermillion bytownite anorthosite, and the rock from the mouth of the Seine anorthite anorthosite."

The following analyses will show the close resemblance there is in chemical composition between the South Sherbrooke anorthosite and that described by Dr. Coleman from the mouth of the Seine (p. 227).

Anorthosites of Ontario and Quebec.

Judging from the general appearance of some varieties of the rock from Eastern

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[6] Fifth Report Bureau of Mines, pp. 99 and 100, and Journal of Geology, Chicago, November-December, 1896. Reprinted in Canadian Record of Science, vol. VII., No. 4, 1897.

NOTE.—Since the above was in type the writer has met with other analyses, made years ago. These taken together with those of the rocks from Seine river and South Sherbrooke show that basic anorthosite is not so rare as has been thought. The two Ontario localities to which reference has just been made are about 800 miles distant from each other.

	Russia. IV.	Ottawa, Ont. V.
SiO_2	46.54	47.40
Al_2O_3	30.73	30.45
Fe_2O_3	3.28	0.50
FeO	1.18	....
MnO	....	....
CaO	15.45	14.24
MgO	1.35	0.87
Na_2O	1.36	2.82
K_2O	0.52	0.38
CO_2	....	2.00
H_2O	0.04	Volatile
	100.40	98.96
Sp. Gravity	2.73	

IV. Analysis quoted by F. Zirkel, Tschermak's Min. Mitt., 1871, page 62. The rock is described as being composed of anorthite and hornblende in the proportion of 90 of the former to 10 of the latter.

V. The analysis is by T. Sterry Hunt, who thus describes the specimen examined: "A greenish-white granular variety of anorthosite rock, from a boulder near Ottawa, having a density of 2.73. This is a portion of the specimen upon which Dr. Thompson founded the species named by him bytownite . . The rock is coarsely crystalline and made up of black hornblende, with a little sphene, and a white triclinic felspar, the cleavage surfaces of which are sometimes half an inch broad, and beautifully striated." Geology of Canada, 1863, page 79.

Most writers state that labradorite is the essential constituent of what they call the typical anorthosites. It would seem that this is owing to the fact that few analyses have been made of these rocks. Moreover, it may be said that only comparatively restricted areas have been examined. The most of Hunt's analyses and those of other workers on this continent were on samples from the district in Quebec which lies adjacent to the St. Lawrence river, and from the adjoining region in the United States to the south. The assumption that labradorite is the typical felspar of those rocks may moreover be due to the fact that most of the areas of anorthosite to which attention has been directed are of large size, and thus, for various reasons, would on the whole be more acidic in character than smaller outcrops. From the analyses which have been quoted by the present writer from Ontario and Russia, it would seem that no one plagioclase should be considered the typical constituent of these rocks.

Rosenbusch (Elemente der Gesteinslehre, pages 151 and 153) quotes four analyses of anorthosites; Kemp (Handbook of Rocks, page 49) three, and Adams' (N. J. Fur. Min. 1893, page 494) two. These range in percentage of silica from 53.42 to 59.

Ontario albite anorthosites also occur associated with the corundum-bearing group.

	I. Seine River.	II. South Sherbrooke.	III. Rawdon, Que.
SiO_2	46.24	47.32	54.45
$Al_2 O_3$	29.85	30.36	28.05
$Fe_2 O_3$	1.30	1.35	0.45
FeO..........	2.12	1.55	.....
MnO..........	trace	.....	.....
CaO	16.24	15.45	9.68
MgO	2.41	2.44	.....
$Na_2 O$	1.98	1.88	6.25
$K_2 O$.........	0.18	0 66	1.06
CO_2	1.03	0.58	.....
$H_2 O$	.....	0.10	0.55
Total	101.35	101.69	100.49
Sp. Gravity ..	2.85	2.73	2.69

The following analyses, made by Mr. Lawson, show the composition of the two constituents of the South Sherbrooke anorthosite. For comparison the theoretical composition of a plagioclase, $Ab_1 An_4$, quoted by Zirkel[7], is given, as well as the composition of a hornblende from hornblende gabbro quoted by Rosenbush[8].

	Bytownite.		Hornblende.	
	I.	II.	III.	IV.
SiO_2	48.12	48.03	41.40	39.58
TiO_2	....	....	....	trace
$Al_2 O_3$	34.54	33.48	15.39	14.91
$Fe_2 O_3$	0.36	....	7.01	4.01
FeO	....	....	7.17	10.67
MnO..........	....	....	trace	trace
CaO	16.30	16.28	12.53	11.76
MgO..........	trace	....	10.31	13.06
$K_2 O$...... ..	0.15	....	1.56	0.62
$Na_2 O$	1.91	2.26	3.58	2.87
$H_2 O$...... .. (ignition)	none	....	0.81	2.79
	101.38	100.00	99.76	100.27
Spa. Gravity ..	2.731	2.735	3.188 at 15° C	3217—322[2]

I. Bytownite from the Anorthosite of South Sherbrooke, Ont.

II. Bytownite, $Ab_1 An_4$, given by Zirkel.

III. Hornblende from the Anorthosite of South Sherbrooke.

IV. Hornblende from a Hornblende Gabbro, quoted by Rosenbusch.

It will be seen that there is a remarkably close agreement between the theoretical composition of bytownite, $Ab_1 An_4$, as regards the percentages of the silica, lime and alkalies and that of the felspar from the South Sherbrooke rock. The proportion of alumina in the latter is however over one per cent. higher than that of the theoretical percentage. This may be due to the presence of a small amount of corundum embedded in the felspar in a very fine state of division, as this mineral occurs, as has been stated, in parts ot the rock. None of it was identified however, either by megascopic or microscopic examination, in the specimen analyzed. In thin sections under the microscope the felspar is seen to contain numerous crystallite-like inclusions It is possible that some of these are corundum.

The hornblendic constituent of the anorthosite is seen by the analysis to have the composition of the typical variety, or what is called common hornblende.

Oso in Frontenac County.

Westward Extension of the Belt.

From the boundary of the township of South Sherbrooke the belt of corundum-bearing anorthosite runs westward into the adjoining township of Oso in Frontenac county. During the little time I spent in this township however I did not succeed in finding the belt so well defined as in South Sherbrooke, although corundum was found in the rock in situ at two or three places and anorthosite boulders carrying corundum were found lying south of a line which runs several miles to the west, thus showing that the belt continues for a considerable distance across country.

As only a hurried walk was made through this part of the township the location of the outcrops of rock and the distribution of the corundum-bearing glacial boulders can be only approximately stated. This is owing also in some measure to the fact that some of the streams and small lakes were found to be incorrectly laid down on the township map. In a general way it may be said that the belt of corundum-bearing anorthosite enters Oso near the northern edge of Rock lake, which lies at the boundary of the townships of South Sherbrooke and Oso. This is near lots nine or ten in the seventh and eighth concessions. From this point the belt, judging from the position occupied by the glacial boulders, runs southwestward about midway between the southern edge of Sharbot lake and the northern extremity of Crow bay, which is an extension of Bobb's lake. No clearly defined belt was found here, but considerable rock in place resembled that farther east, and this rock crosses the Kingston and Pembroke railway a short distance south of Olden station. Just east of the railway track the rock was found to be associated with crystalline limestone. At the side of a spring which has been fitted up with a curb, and which is situated just over the fence on the east side of the track near some farm buildings, there is a boulder which carries the characteristic light colored corundum of the district. A little to the southeast of these buildings and along the wagon road to the east numerous similar boulders occur, scattered over the surface of the ground. Down the track a mile or more south of Olden station other boulders which carry corundum occur. All the boulders referred to are rather dark in color on weathered surfaces, but have a somewhat characteristic appearance, due to a bluish or purplish shade of color, which can be made out when some distance from them, and thus serves to distinguish them from the boulders of "trap" and other dark colored varieties of rock which are associated with them.

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[7] Petrographie, 2nd edition, page 221.

[8] Elemente der Gesteinslehre, page 148

Around Eagle Lake.

West of the railway track the belt runs towards the north end of Eagle lake, of which the greater part lies in the northeast corner of the township of Hinchinbrooke. A boulder carrying corundum was found at the roadside about one mile north of the village of Parham, which is situated to the southwest of the lake. As none of the rock was found in place around the north shore of the lake, it would appear that the belt runs through the lake or along its southern edge. The rock may be in place on some of the islands of the lake, which time did not permit us to examine. This belt is likely continued to the southwestward of Eagle lake, and other outcrops of the corundum-bearing variety will likely be found in place here if a careful examination be made of the territory.[9]

The Parham Gabbro Area.

The track of the Kingston and Pembroke railway runs through some "cuts" just north of Parham station. The rock in these is very coarse grained and dark in color, and on microscopic examination is seen to belong to the gabbro family. The chief constituents of the rock are basic plagioclase and pyroxene. The pyroxene consists in some specimens of both diallage and hypersthene, so that it would be as proper to call the rock a norite as a gabbro. Both the diallage and the hypersthene contain the inclusions characteristic of these minerals. The inclusions here are however striking on account of their comparatively large size, and have been referred to in a paper published some three years ago.[10]

Other minerals in the Gabbro.

Other minerals occurring in subordinate amounts in this gabbro are biotite, apatite, magnetite and pyrite, besides other accessory constituents of less prominence. Stringers of quartz of secondary origin are also sometimes present. An interesting fact in connection with part of the gabbro is that some of the basic plagioclase on microscopic examination is found to be altering into scapolite, as shown in Fig. 3. This mass then represents a stage in the alteration of gabbro into the scapolite rocks which are so characteristic of some parts of the region under consideration. In the typical scapolite rocks the essential constituents are scapolite and secondary hornblende. The former mineral as stated is believed to come from plagioclase, and the latter appears to be derived from pyroxene by alteration. In some varieties of the scapolite rocks, which will be hereafter referred to in speaking of some of the iron ore deposits, none of the plagioclase or pyroxene remains unaltered.

Part of the gabbro mass just north of Parham station lies to the east of the railway track and part of it extends westward to near the shore of Eagle lake.

The phosphate deposit known as the Boyd Smith or Eagle lake property lies at the edge of the mass and near the shore of Eagle lake. This deposit has been described in the Report of the Royal Commission on the Mineral Resources of Ontario, 1890. While most of the phosphate has been mined at the edge of the igneous mass, still some outcrops of the mineral are surrounded by the gabbro with no other rocks intervening. A considerable amount of titaniferous magnetite also occurs on this property in the gabbro, and some of the ore has been blasted out. This magnetite, like other titaniferous varieties, carries a small amount of nickel and cobalt.[11]

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[9] Since the above was written outcrops of pink syenite-pegmatite carrying corundum have been found some miles to the southwest, in the township of Hinchinbrooke.

[10] W. G. Miller and R. W. Brock, Canadian Record of Science, Oct., 1895.

One specimen was found to contain 0.1974 per cent. of the metals. A fine grained variety from the same deposit was found to contain 0.5648 per cent. of nickel and 0.2622 per cent of cobalt. Samples of pyrite in association with the gabbro on the same property gave 1.6785 per cent. of nickel and 0.9847 per cent. of cobalt. All these analyses were made by Mr. F. J. Pope, M. A., late demonstrator in the Kingston School of Mining.

Scapolite Rocks.

Scapolite associated with Iron Ores.

As has been stated, some of the basic plagioclase in the Parham gabbro mass can be seen, when the rock is examined in thin sections under the microscope, to be more or less altered into scapolite. There are other large masses of the rock in the district in which the plagioclase appears to have been completely altered into scapolite and the pyroxene into hornblende. Again there are masses of gabbro-like rocks intermediate in mineralogical composition between the Parham mass and these masses in which the felspar is represented entirely by scapolite. Many of these scapolite-bearing rocks are found in association with iron ore deposits. Very often the scapolite rock forms one wall of the ore body while the other wall consists of usually somewhat impure crystalline limestone. A deposit of this character is that known as the Glendower mine, near Bedford station on the K. & P. railway. Here the foot wall of the deposit is a scapolite rock which in the field has the general appearance of a somewhat coarse gabbro, but when examined in thin sections under the microscope the light colored constituent is seen to consist almost entirely of scapolite, with some calcite, while the dark constituent is hornblende. See Fig. 4.

The scapolite rock is much freer from oxides of iron than is ordinary gabbro, and it would seem as if in the process of alteration of the gabbro, now represented by the scapolite rock, the iron oxides had been leached out and deposited from solution, thus giving rise to the iron ore body.

In his description of the corundum district of Burma Prof. J. W. Judd[12] states: "The study of the Burma limestones leads to the conclusion that the basic gneisses may undergo a corresponding metamorphosis, the breaking up of the lime-felspar leading to the formation of an unstable scapolite, from which and from other unstable minerals originate, as a consequence of further change, the calcite and dolomite." It may be added that in Eastern Ontario it is possible that some of the crystalline limestones which are so intimately associated with scapolite rocks, which latter are alteration products of igneous rocks, may represent the extreme forms of the alteration of these igneous rocks.

The scapolite rock from the Robertsville mine, which forms one of the walls of the magnetite deposit, in mineralogical composition stands between the Parham gabbro and the scapolite rock of the Glendower mine. I consists essentially of scapolite, plagioclase, both of which occur in large amounts, and hornblende. The microscopical characters of this rock were described some years ago by Dr. F. D. Adams and Dr. A. C. Lawson.[13]

Corundum in other Countries.

Recent Reports by Foreign Authors.

In last year's report, p. 213, a brief account was given of the modes of occurrence of corundum and emery in different countries. Since the publication of that report two important monographs have appeared on the subject. For a copy of one of these I am indebted to Dr. T. L. Walker of Calcutta. This valuable report on the corundum deposits of India, consisting of 79 pages, is by Mr. T. H. Holland.[13] The other publication referred to is by Josef Morozewicz, and deals with the artificial production of corundum and other minerals in magmas.[14] A brief account is also given of the modes of occurrence of corundum in Russia. The volume consists of reprints of articles from an Austrian periodical, and I am indebted to the kindness of the author for a copy of it.

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[11] Seventh Report Bureau of Mines, pp. 230 to 232.

[12] The Rubies of Burma and Associated Minerals. Phil. Trans. Roy Soc. London, vol. 187, p. 205.

[13] Can. Rec. Science, 1889, page 198.

[13] A Manual of the Geology of India, Economic Geology part I, Corundum by T. H. Holland, A.R.C.S., F.G.S., Deputy Superintendent Geological Survey of India, 1898.

In India.

As corundum occurs under many forms in India, and some of its modes of occurrence there are similar to those under which the mineral occurs in Ontario, it seems advisable to give a brief review of Mr. Holland's paper in this report.

The home of Corundum.

In the introduction to his report Mr. Holland states that "The Indian Empire can with very good reason be claimed as the home of corundum. The name corundum—under which the dull-colored and non-transparent forms of natural alumina have generally been known since the introduction into Europe of a large number of Indian specimens towards the end of the last century—is only a modified form of the Sanskrit word korund. Not only are there large deposits in India of the common form of this mineral, . . . but the most highly prized specimens of its transparent red variety, the ruby, have been obtained from the famous mines of Burma, whilst the mines of Kashmir are noted for the size and transparency of the blue variety, sapphire."

Mr. Holland does not deal with corundum as an ore of aluminium, as he states that the high price of the mineral for abrasive purposes at the present time, in addition to there being no processes as yet devised for the extraction of the metal from the mineral, prevent corundum from entering into competition with other ores which contain a lower percentage of the metal but can be sold at a lower price.

Supposed Medicinal and Magical Properties of the Gem Varieties.

An interesting account is given of the views which have been held concerning the character and relations of corundum in the mineral kingdom. Reference is made to the supposed magical and medicinal properties of the gem varieties. It is stated that the ruby and sapphire, known as "perfect corundum," were prized by the ancients "for their beauty and supposed efficacy in medicine or magic." A quotation is given from an ancient author by whom the mineral is called hyacinthus. "This is the gem that feels the influence of the air and sympathizes with the heavens, and does not shine equally if the sky be cloudy or bright. Besides, when put in the mouth it is colder than other stones. For engraving upon indeed it is by no means adapted, inasmuch as it defies all grinding; it is not however altogether invincible, since it is engraved upon and cut into shape by means of the diamond." Even at the present time, Mr. Holland states, the mineral is thought by the natives to have a medicinal value. "Like many minerals common corundum is used in India for medicinal purposes. The hakims (native doctors) of the Punjab use calcined corundum as a cooling medicine in fevers (dose about 16 grains). They also apply it to wounds to stop bleeding." In fact mythical properties innumerable seem to have been attributed to the common and gem varieties of the mineral. Rubies of certain quality were believed to concern the life, death, wealth, poverty, success, failure, humiliation, exaltation of their owners. Stones of certain character were believed to subject their possessors to lightning strokes, to blows from a weapon, or to loss of domestic animals. To the sapphire among other properties was attributed the power of extinguishing fire, and of curing fever, inflammation and evil passions. It may be added that this belief in the supernatural powers of gems and other inanimate objects is not confined to eastern nations. Even among ourselves at the end of the nineteenth century there are some who consider it ill luck to possess or wear certain gem stones, and everyone has heard of men who carry horse chestnuts in their pockets or wear lead rings as a preventative of rheumatism!

Theory of Mr. Holland on Origin.

Mr. Holland states, p. 10, that "There seems to be no à priori reason why corundum, when occurring as a rock constituent, should require any different explanation than that generally applied to

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[14] Experimentelle Untersuchungen über die Bildung der Minerale im Magma von Josef Morozewicz in Warschau. Separat-Abdruck aus Tschermak's Min. und Pet. Mitt., Band XVIII, Heft 1 und 2. Wien.

ıer simple oxides occurring in a pre-
similar manner." This agrees with
nion expressed by the present writer
ysar's report. Mr. Holland further
;hat until recently the known occur-
of corundum in situ were few, and
ıy account for the tendency there has
ı regard the origin of corundum as due
ısual or secondary circumstances, its
tion having been thought to be due to
tion of mineralizing agents or other
affecting the aluminous rocks in which
rs. "The principal Indian occurrences
ndum in situ can be divided into two
: (1) Those in which corundum is asso-
with basic rocks, and (2) those in which
ociates are distinctly siliceous (acid).
lasses are well represented in India,
most cases where corundum has been
ıssociated with basic rocks intrusions
matite have also been found in the
ourhood." The basic rocks have pyr-
as a predominant constituent. With
associated hercynite, ruby, spinel,
ıte, magnetite, ilmenite, corundum and
minerals. Corundum also occurs in
line limestones, and it has been shown
ıese limestones are intimately asso-
with pegmatite, this association of the
ıeing a constant feature of the Madras
um deposits. In view of Prof. Judd's
ions these limestones are regarded
ıd's as extreme forms of the alteration
ıns. of rocks which are now generally
ıd as igneous in origin. "It seems
riate to link with them (the limestones)
orthite rock containing corundum in
em district of Madras. Although the
ıte matrix was the first described
ıt the occurrences of corundum, this
tion appears to be rare, possibly be-
he anorthite has in many cases been
d to carbonate of lime."
ınnection with the Ontario occurrences
ındum the fact has been mentioned
that corundum has been found in
on
ırio a basic anorthosite, a rock very
ıes. similar in character to the corun-
ıaring anorthite of India No occur-
in this Province are however known
resemble those of India in which corundum is found in highly pyroxenic rocks, or in their altered representative the crystalline limestone. Attention has been drawn however, both in the present report and that of last year, to the frequent association of quartziferous pegmatite with the corundum-bearing rocks of the Province. It has also been stated that the corundum-bearing rocks of Ontario are, in the majority of cases examined, closely associated with crystalline limestones.

"The sapphires of Kashmir occurring in a granite, form a good example of the occurrence of corundum in rocks of acid composition."

In Ontario corundum has not been observed in granite, but the more acidic varieties of syenite which contain the mineral appear, as has been stated, to pass into granite in some cases.

Burma.

Rubies in Crystalline Limestone.

In Burma, which is celebrated for its rubies, the principal mines are those in which the stones are found in crystalline limestone, hill-wash, or in alluvium. In one small area in Upper Burma there are ten distinct bands of crystalline limestone in a distance at right angles to their strike of 2½ miles. Their collective thickness across their outcrops is about 2,670 feet. The gem stones are obtained by washing the detrital matter produced by the weathering down of the limestone. "The limestone itself has also been quarried for the rubies occurring in situ, but the shocks produced by blasting and subsequent hammering of the rocks invariably injure numbers of the gem-stones." At one point in the Coimbatore district "two rocks of different composition and structure are connected with the appearance of corundum . . . The one is the pale gray elæolite syenite of the Sivamalai Hill, and the other a coarse felspar-rock intruded as veins into the former rock." The latter rock is composed of red or deep flesh-colored plagioclase and biotite in large nests of small plates. It is in this rock that the corundum occurs, and it appears to be an original constituent of the rock. Although

Unique occurrence of Corundum in nepheline syenite in Ontario.

corundum occurs in a rock here which is associated with elæolite or nepheline syenite, the mineral has apparently not been found occurring in the latter rock in India. The same appears to be true of all other countries, including particularly the Ural mountain district of Russia and other districts in which both corundum and elæolite syenite occur. Judging from the descriptions of the occurrences of corundum in these countries which have so far been published, Ontario is the only country in which corundum has been observed to occur in elæolite (nepheline syenite). In this Province numerous occurences have been observed by the present writer in which the mineral is embedded in syenite of this character.

In the Salem district corundum occurs under conditions very similar to those which have been stated by the present writer to prevail in the deposits of this mineral in the township of South Sherbrooke. Mr. Holland describes the rock as "consisting of anorthite (indianite) and hornblende chiefly." The specific gravity of a specimen with but little hornblende was found to be 2.824. The corundum is of a "pale, greenish-gray, rarely flesh colour, and occurs sparsely distributed" among the parts of the rock which has a gneissoid structure, which are richer in anorthite. "It takes the form of irregular lumps averaging from one-quarter to one inch in diameter. The crystals do not, as a rule, show the prismatic and pyramidal faces . . ."

This description of the mineralogical composition of the rock and the form and color of the contained corundum applies very well to the occurrence in South Sherbrooke.

In the Salem district, as in the other corundum areas of India, one of the characteristic features is the occurrence of dikes of coarse granite or pegmatite, and reference is also made to the occurrence in this district of dikes of a dark compact trap, both of which rocks are frequently found in the neighbourhood of the Ontario corundum deposits.

Paparapatti Area.

Working rock Corundum for Abrasive purposes.

In the Paparapatti area corundum occurs in the solid rock, and since this is one of the few localities in India in which a have been made to worl deposits in order to extract t eral for abrasive purposes it well to give Mr. Holland's tion of the occurrence, with his con as to the economic value of the d This will be of some assistance in est the relative importance of the Onta posits

"The actual matrix of the corun this area occurs as bands of lenticular of principally deep flesh-colored ort (finely crystalline, and showing un microscope a fine microperthitic or perthitic inter-growth of possibly p'ag in which there is often a considerable tion of sillimanite (fibrolite), rutile, black and green spinel, with biotite, last is especially developed at the pe of each lenticle. The size of these l is sometimes as much as fifteen feet lc eight feet across where actually seen rock. The corundum here differs ent appearance from that of Sittampundi of a deep purplish brown or sometim greenish-gray colour, and is always re crystallized into hexagonal prisms great number of variously inclined py faces imperfectly developed, and so the prism an elongated barrel or oven shape.

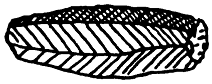

Fig 5. Crystal of Corundum showing the c faces due to alteration of the prism and pyram well as traces of the rhombohedral parting p Paparapatti area, Salem district. Natural size Holland).

"In size they vary from extremely grains and crystals, only visible in a scopic section, to large crystals several long and from one-fourth to one inch meter. The characteristic parting parallel to the rhombohedron are easil manifest by breaking the crystals, and times traces of these planes are visible prism faces (Fig 5). Occasionally also bination of the rhombohedron and pris be seen in a single crystal. Each cry surrounded by a shell of purer orth

Rapids above High Falls, York Branch River. —W. K. George.

High Falls on York Branch River, from a point above the Falls. W. K. George.

At the foot of High Falls on York Branch River. —W. K. George.

34 Second Falls on York Branch River at Bronson or Lancaster Farm (18 ft.). —Harris.

View on the York Branch River. —Harris.

Foster's Rapids on the York Branch River —Harrris.

Corundum-bearing rock on Robillard's farm, lot 3, con. 18, Township of Raglan. —Harris

Corundum-bearing rock on Robillard's farm, lot 4, con. 18, Township of Raglan. —Harris.

lly flesh-coloured, but sometimes white,
a thickness of from one-fourth to one-
inch. When a corundum crystal has
›roken out or has dropped out from
:k, the place where it lay can always
:inctly recognized by this shell which
ıs behind. Microscopic examination
that this shell differs from the re-
er of the matrix in the absence of
ǝ corundums, sillimanite and most of
:essory minerals.

is clear from the map that the out-
›f the rock in which corundum occurs
successive lines, roughly parallel to the
of the gneiss, namely, N.N.E.—S.S.W.
his conclusion has since been confirmed
ıe discovery of corundum occurring
precisely similar conditions in the
: taluk to the north, and also in the
ine to the south, making the corundum-
ıg band over 24 miles long. This fact,
ıe circumstance that the mineral occurs
› and probably more parallel bands of
ly different rocks, make the Paparapatti
ı decidedly promising one. Experi-
ı to test the prospect of mining for
dum along this band have been con-
d by Mr. C. S. Middlemiss, on a len-
13 x 8 x 9 feet, near the village of
ıhalli, 2½ miles S.W. by S. of Palakod.
s found that 722 cwt. of matrix-rock
:d 2,845 lb. or nearly 3.5 per cent. of
corundum, at a cost of R 385-2 0, that
3 annas per cwt. of rock broken up and
›. of corundum cleaned.[15] As the chief
ıse was incurred by the mere labor of
ing the rock, which was done entirely
ınd, it is certain that the cost of extract-
he corundum would be greatly reduced
ne crushing and washing machinery had
employed, as of course would be the case
tual mining operations on a large scale."

tive Richness of Ontario and India Deposits.

ıce Mr. Holland—who is in a good posi-
to judge on account of the fact that more
work has been done on corundum
in India than in any other country
—considers the area just described
a decidedly promising one, I have thought it well to quote his description fully, both as to the characteristics of the mineral itself and as to its mode of occurrence, so that comparison might be instituted between these deposits and those of Ontario.

tages
o
dum.

Since in order to work either the India or Ontario deposits on a large scale would require the use of machinery, the cost of mining and crushing the rock in the two countries may be taken as being practically the same. In so far as climatic influences, transportation facilities, water for washing the crushed material and for use in generating power, electric or otherwise, are concerned, the Ontario deposits are certainly as well situated as any in the world.

The chief constituent in the India rock, as in that of Ontario, is felspar. But in addition to the felspar the India rock contains often a considerable proportion of fibrolite, rutile and spinel. These minerals are heavier than felspar and have specific gravities of, respectively, 3.23 to 3.24, 4.18 to 5.2 3.5 to 4.1, that of the felspar being 2.57. On washing away the felspar these minerals would tend to come down with the corundum, which has a specific gravity of 3.95 to 4.10. and would thus give an impure product. Mica occurs in the rock from both districts, and hence this mineral may be left out of consideration in making a comparison of the treatment of the two. The heavy mineral which comes down with the Ontario corundum on washing is magnetite, but this mineral is easily and cheaply isolated by passing the mixture over a magnetic separator. Moreover the magnetite, which averages about four per cent. of the rock treated and is of good quality, is in itself a by-product of value for use as an iron ore.

In the mill tests of the Hastings rock made last year by Prof. DeKalb, the corundum obtained from one sample of 550 lb. represented 12.74 per cent., and in another sample of 1250 lb. the corundum separated was 15.50 per cent. of the rock treated.[16] Since the India rocks yielded only 3.5 per cent. of pure corundum, the Ontario deposits would seem to have a considerable advantage over

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3 annas=about 11 cents. The cleaned corun-
therefore cost 2.82 cents per pound.

[16] Seventh Report Bureau of Mines, p. 246.

those of India as regards the percentage of mineral in the rock from the two districts.

As stated in last year's report, p. 225, it is difficult to get much information from Government reports concerning the percentage of corundum carried by the rock in deposits which have been worked. The United States reports state that the producers of the mineral are averse to giving information concerning the corundum industry. The percentage quoted from the India report and two others given in a United States report are the only ones the writer has met with. In the latter report one vein from two to six feet wide is said to average 15 per cent. corundum. The material of another deposit in which the vein is from four to 15 feet wide is said to average probably 10 to 15 per cent. corundum.[17] It would thus seem that the Ontario rock contains at least as high a percentage of the mineral as do the deposits with which it will have to compete if worked.

Judging from the characteristics of the India corundum given in the description which has been quoted, the quality of the Ontario mineral is not inferior for abrasive purposes. In fact much of the mineral in the deposits of this Province appear to be of a superior quality to that of the Paparapatti district. The parting planes in the India corundum seem to be more perfectly developed than they are in much of the Ontario mineral, and for abrasive purposes it is desirable that they be not well developed.

With regard to the extent of territory over which deposits are found in the two districts under consideration, there does not seem to be much difference. Mr. Holland states that the mineral has been found along one band which is about 24 miles in length, and that there are two and probably more parallel bands of somewhat similar character. In Ontario corundum has been found, as has been stated in this report, in three different bands or belts of rock. These belts taken together have a length of about 100 miles.

The lenticles or deposits in which the Indian corundum occurs are stated by Mr. Holland to be "sometimes as much as 15 feet long by eight feet across where actually
seen in the rock." From the desc
which have been given of the surfac
urements of some of the Ontario d
such as the York river deposits and
it will be seen that those of this P
are, to say the least, not smaller than
of the India district which is under
eration.

Corundum Rocks of India.

Geological Characteristics of India Corundum.

In summing up the geological cha
istics of the India corundum region
fessor Judd says:[18] "In al
districts (in Southern Asi
rocks containing corundum
to be highly crystalline gn
sometimes passing into schists, an
quently including masses of limeston
dolomite, the latter rocks being as
highly crystalline, and containing ma
cates and other minerals. Intrusive
of granite or pegmatite also occur. T
no evidence, so far as I am aware, o
to the view that the whole of these
must be regarded as of Archæan age."
the descriptions which have been gi
this report and in that of last year
Ontario corundum region it will be see
there is a strong resemblance betwe
rocks of the two regions. The simila
not less strong when we consider the
rence of certain special rocks of th
regions, such as the nepheline syeni
the scapolite gneisses.

In the Ontario region however the
dum occurs as an original constitue
igneous rocks, while in India most
corundum, including the gem varieties,
in crystalline limestones and is a prod
metamorphism.

In Russia.

Occurrences of the Mineral in parts of Russia.

Reference was made in last year's
to the occurrence of corundum in Russi
a little was said of the char
of the rocks with which the m
is associated in that empire.

Morozewicz, in the excellent monogr
which reference has been made, and

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[17] Mineral Resources, U.S., 1893.

[18] The Rubies of Burma and associated Mi
by C. Barrington Brown and J. W. Judd.
Roy. Soc. London, 1896, p. 191.

was published during the winter of 1898-9, in addition to describing the interesting results of his experiments on the artificial production of corundum, gives an account of the modes of occurrence of the mineral in some of the Russian localities visited by him. As in these localities the mineral occurs under conditions similar to those under which it is found in Ontario, it will be well to mention in this report some of the characteristics of the corundum-bearing rocks of Russia described by this author.

Corundum-Anorthite Rock.

Associated with Anorthite.

The variety of corundum-bearing rock of Russia which has attracted most attention is that in which the mineral occurs associated with anorthite. This rock occurs in stocks or very large dikes. It is associated with granite and serpentine, which lie on either side of it at the locality on the river Borsowka. The rock at this locality is medium to fine grained in texture, and is made up of crystals of corundum scattered through a gray ground mass in which occur plates of biotite. The finer grained varieties of the rock have at times a gneissoid structure. In some cases the corundum occurs in long hexagonal crystals, and in others it occurs in small pyramidal forms. Fresh specimens show no trace of alteration products, such as calcite or chlorite. Varieties of rocks, differing in the size of the grain, are seen in thin sections, when examined under the microscope, to possess the same constituents but in varying proportions. The gneissoid variety contains the most biotite, while the finest grained contains more secondary material. The chief constituents of the rock are corundum and anorthite, together with spinel and biotite. Apatite and zircon occur as accessory constituents. The secondary minerals present are muscovite, chlorite, kaolin and chrome iron ore. The following is the order in which the primary constituents have crystallized out of the magma, viz.: zircon, spinel, corundum, anorthite, biotite. It is claimed by Morozewicz that the corundum-anorthite rock forms a new type of an alumino-silicate magma and is called "kyschtymit" by him.

The Ontario corundum-plagioclase rock which has been described in this report is similar in character to this Russian rock, the chief difference between them being that the felspar in the specimen of Ontario rock analyzed was somewhat more acid than that of the Russian variety, and in place of the biotite of the Russian rock the corundum-anorthosite of this Province contains hornblende.

It would seem that instead of introducing the name "kyschtymit" for the corundum-anorthite rock of Russia, it would be better to use the name anorthosite, which has long been used by Canadian geologists and others for igneous rocks whose characteristic constituent is a plagioclase.

Corundum-Orthoclase Rocks of the Urals.

In addition to the basic or anorthite corundum-holding rocks just described, other rocks of a more acidic character occur in the Urals. The varieties of these latter rocks which carry corundum contain as their chief constituent, in addition to this mineral, acidic felspar or orthoclase.

Morozewicz makes two divisions of these orthoclase rocks, the coarse grained being called corundum-pegmatite and the finer grained corundum-syenite. The rocks occur as dikes or masses in gneiss. The corundum occurs in them in large as well as in very small microscopic crystals.

Corundum-Pegmatite.

In hand specimens the pegmatite is seen to consist of coarse grains of yellowish orthoclase through which penetrate long hexagonal crystals of blue corundum. The crystals of orthoclase often show Carlsbad twinning. Secondary white mica often shows on the surface of the corundum crystals. The length of the corundum crystals reaches 10 centimeters (about 4 inches) and their diameter is about one centimeter. The small crystals seen in thin sections under the microscope have a length of 1 to 1.5 mm., and a thickness of 0.5 mm. The small crystals are characterized by the possession of pyramidal terminations, a feature which was not observed in the large ones. Again the small crystals are perfectly colorless, while the large ones possess a clear

The small crystals are com- sed in orthoclase.

oclase is almost exclusively nto micro-perthite. Numerous ripes of albite are mixed through he mass of the orthoclase. In o corundum, the orthoclase encloses s hairs of rutile and short needles e and zircon. Products of weather- represented by kaolin, and limonite resent. A mineral which occurs in black, opaque, glistening prisms in ne orthoclase and corundum is present, s true character was not made out by zewicz.

ndum- ite.

describing the corundum-syenite the or states that a rock made up of a granular mixture of corundum, orthoclase and biotite is not seldom t with in the Urals. The rock occurs in anite in the form of stock-like segregations Anhaüfungen). Some of these occurrences re poor in biotite, while others are pretty rich in the mineral. The corundum in rock of the former kind is in short prismatic blue crystals, while in the latter kind the mineral occurs in broad dark gray plates. In both cases the corundum may be looked on as playing the part of quartz in granite. If the corundum in the syenite were changed to quartz the rock would become a typical granite.

Similarity to the Ontario Mineral in Occurrence.

Judging from Morozewicz' description of the corundum-bearing rocks of Russia it would seem that corundum has not yet been found occurring in that country in nepheline syenite. With this exception the occurrence of the mineral in the igneous rocks of the two countries, Russia and Ontario, shows a close parallel. It is altogether likely that further search will prove that the mineral does occur in nepheline syenite in Russia, since this rock is known to be associated in places with the corundum-bearing varieties. As has been shown by an analysis quoted in this report, some of the rocks of this Province which in hand specimens would not be considered to contain nepheline do contain this mineral. There is a very gradual passage from one variety of syenite to another.

Alumino-Silicate Magmas.

Since the greater part of known igneous rocks belongs to alumino-silicate magmas, and since the principal and least varying components of such rocks are silica and alumina, these compounds are taken by Morozewicz as a basis for classification of alumino-silicate magmas. The following divisions are made :

GROUP A.

1. Magmas supersaturated with alumina, e.g., corundum syenite.
2. Magmas saturated with alumina, e.g., syenite.
3. Magmas not saturated with alumina, e.g., gabbro.

GROUP B.

1. Magmas supersaturated with silica, e.g., granite.
2. Magmas saturated with silica, e.g., syenite.
3. Magmas not saturated with silica, e.g., nepheline syenite.

In connection with 3A and B it may be stated that nepheline syenite is saturated with alumina, but not fully saturated with silica.

Probable wide extent of Corundum-bearing Rocks.

Morozewicz claims that rocks of the type of 1A, although at present so far as known are of rare occurrence, will be found to occur more widely when search is made for them. The discoveries of corundum-bearing rocks over such a wide tract of territory which have been made in this Province in old settled districts within the last three years confirm the author's view. Rocks of similar character to those of Eastern Ontario are known to occur not only in other parts of the Province, but also in the Province of Quebec, and it seems not unlikely that if searched for corundum will be found over a wide extent of territory along the southern edge of the Canadian Archæan protaxis. Nepheline has been found in boulders in the central part of the Province, the Pic island in lake Superior, and in rock in place in the Rainy River district towards its western boundary, as well as in the eastern part and in the Province o Quebec.

Magnetite and Spinel.

Ontario rocks have considerable magnetite about four per cent., associated with the corundum, while those of the districts of Russia under consideration carry spinel. But as these are isomorphous compounds the two occurrences may be considered as being closely identical. The percentage of magnesia in most of the Ontario corundum rocks is very low—analysis showi merely a trace. Zinc spinel however occurs at one or two places in the township of Raglan.

General Conclusions.

Classes of Igneous Rocks.

As has been stated in the preceding pages, the igneous rocks in which corundum has so far been found to occur in Ontario are of four kinds, viz.: (1) Syenite (mica, etc.), (2) Syenite-pegmatite, (3) Nepheline syenite, (4) Anorthosite. The following table shows which of these corundum bearing varieties are found in India and Russia according to the descriptions given by Holland and Morozewicz:

1. Syenite – Ontario, India and Russia.
2. Syenite-pegmatite – Ontario, India and Russia.
3. Nepheline syenite – Ontario only.
4. Anorthosite – Ontario, India and Russia.

It may be added that corundum occurs in another igneous rock in India, viz., granite. This mode of occurrence of the mineral has up to the present not been observed in Ontario, although, as has been stated, the corundum-bearing varieties are sometimes cut through by quartziferous pegmatites, and the corundum-bearing syenite appears to merge off into granite in some cases.

Locations of Ontario Deposits.

Situation favorable for Industrial Development.

The index map which accompanies this report (p 206) shows the locations of the corundum deposits. The distances of the deposits by rail from some of the chief cities of the Province are stated on the map. The extension of the Pembroke Southern Railway from Golden Lake station to Bancroft, for which a Government bonus has been granted, will cross the main corundum belt and will greatly increase the shipping facilities. The Central Ontario Railway is also being extended to Bancroft.

Water-power, Labor and Supplies.

Reference was made in last year's report to the favorable situation of the deposits as regards waterpower, labor and supplies. Excellent waterpowers occur on both the Madawaska and York Branch rivers in the vicinity of some of the main deposits. The district is well able to supply labor and agricultural products, and there is abundance of wood for fuel.

Statistics of Corundum.

Exact information has not been available.

As has been previously stated, it is difficult to get reliable statistics concerning the production of corundum. Some Government reports state that the producers are averse to giving information. The Engineering and Mining Journal of New York gives the following as being the amounts of corundum and emery produced in the United States in 1897 and 1898:

	1897.	1898.
Corundum, tons..........	293	786
Emery, "	1,900	2,956

The value of the two materials taken together in 1897 was approximately $112,000 and in 1898 it was $210,000. The value of emery grains and rock imported into the United States in 1897 was about $130,000 while in 1898 it was $133,399. The U. S. Government reports give the total production of corundum and emery in the country in 1898 as being 4,064 tons, valued at $275,064.

Other abrasive Materials.

Of other abrasive materials produced the Government reports state that the garnet had a value of $86,850, and pumice stone $13,200. Some other materials, such as crushed steel and carborundum, are used quite extensively. The value of the crushed steel produced in 1898 is said to be $46,200, and of carborundum $151,444.

Difficulty of procuring Corundum Supplies.

The writer was informed by a gentleman who visited the corundum district of North Carolina recently that prospecting for the mineral is being actively carried on in that State, but without much success in the discovery of new deposits. Users of the material have also informed the writer that they have great difficulty in obtaining sufficient supplies of the material. One firm in Great Britain asserts that it has given up trying to secure corundum, and prefers to use high grade emery on account of the difficulty experienced in securing a constant supply of corundum and on account of much of the material supplied under that name being adulterated, or being only imperfectly separated from associated minerals.

Prices of Abrasive Materials.

The following list of prices of corundum and other materials used for abrasive purposes is taken from the Engineering and Mining Journal of New York :

Abrasives.	Measure.	Price.
Carborundum grains, f.o.b. Niagara Falls.......... ..	lb.	$0 10
Corundum, N.C., ...	lb.	.07 @ 10
do. Chester	lb.	.04½@ 05
Emery grains, Turkish......	lb.	05
Pumice stone, Am. powdered.	lb.	.01 3-5@ 02
Rouge.............	lb.	.17 @ 30
Tripoli, prepared	short ton.	20 00

The average value of garnet produced in 1898 was $28.78 per 2,000 lb.

It seems likely that if corundum of good quality were put on the market at a somewhat lower price than at present quoted the result would be that it would displace to a large extent inferior abrasive materials and thus its consumption would be largely increased.

Abrasive Quality of Ontario Corundum.

Comparative Tests at Hamilton.

A quantity of grain corundum produced from rock quarried in the township of Carlow, Hastings county, and milled in the laboratory of the School of Mining, Kingston, was submitted to the Hart Emery Wheel Co. of Hamilton, Ontario, for a test of its abrasive qualities. In a letter to the Director of the Bureau of Mines, dated March 2, 1899, they state in part as follows in reference to the test :

"The tests were made with disks 12 in diameter and from ½ to 1 in thickness, the small quantity of Hastings corundum procurable preventing the use of larger disks. The wheels were placed on opposite ends of the same arbor ; one made of Hastings corundum being placed on one end, the other end being either supplied with North Carolina corundum or carborundum. The speed at which the arbor ran was 1,700 revolutions per minute. The pieces of metal ground in the series of tests were of (1) Brass, (2) Cast Iron, (3) Wrought Iron and (4) Cast Steel, and the trial bars were about 1 by ½ in size."

The company report having made 23 comparative tests. Four of these were with what they describe as the Hastings "special," but as they do not state what is meant by this term the results of these four tests are not included in the following tabular summary, which shows the results of the other seventeen tests.

1. Comparative Test of Hastings (Ontari[illegible]) Corundum and North Carolina Corundum [illegible] Brass :

Material.	Time of test.	Net ground.	Exce[illegible] grou[illegible]d.
Hastings	3 hours.	1 lb. 13¾oz.	[illegible]
N. Carolina	3 hours.	1 lb. 13 oz.	

1A. Comparative Test of Hastings Corundum and Carborundum on Brass :

Material.	Time of test.	Net ground.	Excess ground.	Excess lost on weight of wheel.
Hastings C	2 hours.	8 oz.		
Carborundum ..	2 hours.	15 oz.	7 oz.	
Hastings C	1 hour.	11¼oz.	......	½ oz.
Carborundum .	1 hour.	1 lb. 5½oz.	10¼oz.	

These two comparative tests of Hastings corundum and carborundum on brass cannot be relied on, as will be seen from the figures, both materials being said to grind away more brass in one hour than in two. Moreover the total amount of brass said to have been ground away by Hastings corundum in these two tests, which lasted for a total time of three hours, two hours and one hour respectively, is 1 lb. 3¼ oz. while in the three hours' test already referred to in which Hastings and North Carolina corundums were compared, Hastings is stated to have ground away 1 lb. 13¾ oz.

2. Comparative Tests of Hastings Corundum and North Carolina Corundum on Cast Iron.

Material.	Time of test.	Net ground.	Excess ground.	Excess lost on weights of wheel.
Hastings C .	2 hours.	2¼oz.		
N. Carolina C...	2 hours.	4¼oz.	2	
Hastings C .	1 hour.	2 oz.	......	½ oz.
N. Carolina C. .	1 hour.	3½oz.	1½	
Hastings C .	1 hour.	1¾oz.		
N. Carolina C...	1 hour.	3 oz.	1¼	
Hastings C . .	3 hours.	8¾	5¼	
N. Carolina C.	3 hours.	3½	......	1¼

In these four tests lasting for a period of 7 hours the Hastings corundum ground away 14¾ oz. of cast iron, while the N. Carolina ground away 14¼ oz. Judging from the fourth test lasting 3 hours the Hastings wears much better on this material than the North Carolina. This may be owing to the grains of the former material breaking away as the wheel wears down, so as to present constantly a good cutting surface. Some wheels as they wear down show a tendency to become more or less "greasy" on their cutting surface.

Comparative Test of Hastings Corun-
d Carborundum on Cast Iron :

Material	Time of test.	Net ground.
....	1 hour.	2¾ oz.
dum	1 hour.	2¾ oz.

mparative Test of Hastings Corun-
nd North Carolina Corundum on
t Iron :

ial.	Time of test.	Net ground.	Excess ground.	Excess lost on weight of wheel.
C....	3 hours.	3¼oz.		
a C...	3 hours.	4¼oz	1	¼ oz.
....	1 hour.	1 oz.		
a C...	1 hour.	2¼oz.	1¼	

Comparative Test of Hastings Corun-
d Carborundum on Wrought Iron :

aterial.	Time of test.	Net ground.	Excess ground.
....	1 hour.	2¾oz.	
dum	1 hour.	4 oz.	1¼
....	2 hours.	4½oz.	
dum	2 hours.	9 oz.	4½

of the figures given in tests 3 and
difficult to understand. Working
same material, wrought iron, and
he same conditions, Hastings corun-
one case is said to grind away 3¼ oz.
rs, while in another case it is said to
way 4½ oz. in 2 hours. In another
stings is said to grind away 1 oz. in 1
hile in another experiment it is found
l away 2¾ oz. in the same length of
: will be noted that this latter amount
er than the amount ground away by
lina in the same length of time.

mparative Test of Hastings Corun-
d North Carolina Corundum on Cast

ial.	Time of test.	Net ground.	Excess ground.	Excess lost on weight of wheel.
....	1 hour.	3 oz.	.....	½
a C....	1 hour.	3 oz.		
....	2 hours.	4½oz.	1	
a C....	2 hours.	3½oz.		

Comparative Test of Hastings Corun-
l Carborundum on Cast Steel :

ial.	Time of test.	Net ground.	Excess ground.	Excess lost on weight of wheel.
......	1 hour.	2¾oz.	1¼	
lum .	1 hour.	1½oz	......	1¼oz.
.....	2 hours.	4¾oz.	4¼	¼
lum ..	2 hours.	½oz.		
......	2 hours.	4½oz.	4	
lum ..	2 hours.	½oz.		
.....	2 hours.	5 oz.	2½	
lum ..	2 hours.	2½oz.		
......	1 hour.	2 oz.	1¾	
lum ..	1 hour.	¼oz.	......	¼

Test 4 between wheels of Ontario and North Carolina corundum, made on cast steel and maintained for three hours, shows that the former ground off one ounce more than the latter, or an excess of 15½ per cent. Test 4A between wheels of Ontario corundum and carborundum, made also on cast steel and maintained for eight hours, shows that the former ground off 19 oz. and the latter 5¼ oz., being an excess of 13¾ oz. or 262 per cent. in favor of Ontario corundum. In steel plow works abrasive wheels are largely used, and it is probably the case now that as much of steel as of iron undergoes abrasive treatment in foundries and machine shops.

Testimony from Other Sources.

Dealers and Manufacturers.

Smaller samples of grain corundum than that furnished the Hart Emery Co. have been supplied different companies both in the United States and Europe. In no case has the material been condemned. The following quotation from a letter recently received by the Director of the Bureau of Mines from a London, England, firm to whom some pounds of the grain had been sent voices the opinion of others who have examined the material : "We consider the mineral to be good, and hope some company will be formed for the exploitaton of these corundum deposits ; in which case we shall be glad to hear from you again."[19]

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[19] Since the above was written an additional quantity of corundum-bearing rock has been treated under the direction of Mr. R. Instant in the mill of the Kingston School of Mining. This rock was obtained at the Robillard property in the township of Raglan and weighed 8 tons 650 lb. The method followed in its treatment was the same as that used by Prof. De Kalb and described by him in the Report of the Bureau for 1897. The rock was first broken in a Blake crusher to such a size that the larger fragments had a diameter of about one inch. It was then passed through rolls, after which treatment the larger pieces of rock had a maximum diameter of one-quarter inch. After coming from the rolls the rock matter was sized by means of sieves. It was then treated by the Hartz jig, which through the agency of water separated the minerals of low specific gravity (chiefly felspar and mica) from those of higher specific gravity. These latter were corundum and magnetic iron ore. After coming from the jig the mixture of these two minerals was dried and then the magnetite was freed from the corundum by means of the magnetic separator.

The 8 tons 650 lb. of rock gave by this treatment, after recrushing some of the No. 10 and 12 mesh, the following amounts of the different numbers of cleaned corundum.

No. 10	259 lb.
" 12	467 "
" 16	506 "
" 20	203 "
" 24	221 "
" 30	282 "
" 40	180 "
" 50	155 "
" 60	60 "
" 70	17 "
" 90	10 "
" 100	9 "
Total	2369 "

This equals 14.22 per cent. of the rock treated. In addition there were various small amounts of corundum abstracted as samples at different times, which would aggregate probably 50 lb. Moreover the dust or finest material coming from the crushers was not jigged. This material it was estimated contained about 100 lb. of corundum in a fine state of division. In addition to this some corundum was lost in the tailings from the jigs.

The result of this test agrees with that obtained by Prof. De Kalb on rock from the township of Carlow, which adjoins Raglan on the west. In that test the amount of corundum extracted in the mill was equal to 14.67 per cent. of the rock treated. The rock from both townships was similar in appearance, being coarse grained and for the most part pink in color, forming what is known as syenite-pegmatite

The specific gravities of the various numbers of the grain corundum extracted in the mill test from the Raglan rock were determined. Those of No. 16, 30, 40 and 50 were found to be 3.952, 3.953, 3.976 and 3.945 respectively. Since the specific gravity of pure corundum ranges from 3.95 to 4.10 it will be seen that the product from the mill run of the Raglan rock is practically free from foreign matter.

The X-ray photographs which accompany this report show the form and actual size of the grain of corundum of the different numbers. They moreover show that it is possible by photographing samples of commercial corundum in this way to determine their degree of purity, since corundum grains themselves are not so impervious to the rays as are silicates such as felspar, garnet, chlorite and mica, which are frequently associated with this mineral or are used to adulterate it in commerce.

A dozen or more samples of the grain corundum, each weighing upwards of 100 pounds, produced from the Raglan rocks, were submitted to leading manufacturers of abrasive goods in America and Europe, by whom they were tested and pronounced suitable for use both in vitrified wheels and in those which are cemented together according to the ordinary binding formulas. The Prescott Emery Wheel Co., of Prescott, Ont , report: "For light work for tools the corundum presents a fine cutting surface. If these wheels are too soft or too hard we can easily remedy that by a variance in our formula." The Sterling Emery Wheel Mfg. Co. of Tiffin, Ohio, say: "The samples look very nice and the corundum works well. Please advise us in what quantities you expect to get it out." The Chicago Wheel and Mfg. Co. say that the corundum in the wheels manufactured by them looks well and they are sure the wheels will do good work. The Norton Emery Wheel Co. of Worcester, Mass., state that the result of their tests on the grain corundum to see whether it would work up satisfactorily according to their process was all that could be desired. The manager of the Northampton Emery Wheel Co. of Leeds, Mass., says his company finds it to be a very good quality of corundum so far as their wheel is concerned. The president of the American Emery Wheel Works, Providence, R. I., writes: "We have found this material well suited for certain kinds of grinding, especially for saw sharpening, roll grinding, spindle grinding, and surface grinding on hardened steel. For these purposes and perhaps for some others we believe it will come into extensive use, provided it can be furnished at a reasonable price and that the quality runs uniform. Our experiments indicate that on the above classes of grinding it heats the work less than emery."

A number of wheels, together with bricks, rounds and triangles, made from Ontario corundum by different manufacturers according to different processes, have been shipped to Paris, where they are to exhibited in 1900, along with numerous samples of corundum in the raw and partially manufactured state.

CORUNDUM IN ONTARIO[1]

By Archibald Blue

JUST one hundred years ago, in a paper read before the Royal Society of London and published in its Transactions, Rt. Hon Charles Greville established and named the mineral species Corundum, the crystalline oxide of aluminium ; and we have it on the authority of Professor Judd that in an appendix to Greville's paper the Count de Bournon correctly defined the crystallographic characters of the species. The names of its gem-varieties, sapphire and ruby, had been in use from a much earlier time[2] ; and the name corivindum, or corrivendum, had been given to it by Woodward, in a vaguer way, as early as 1714.

Where Corundum is Found.

Occurrences of the Mineral.

In the western part of Asia Minor, and in some islands of the Grecian archipelago, the crystalline limestone which is interbedded with the schists and gneisses carries a blue corundum mixed with magnetite, which is the emery of commerce. The corundum occurs in smaller quantities as a constituent of granite and gneiss in Silesia, Auvergne and elsewhere in Europe ; in a compact felspar rock in Piedmont ; in dolomite with tourmaline at St. Gothard ; in crystalline limestone, along with numerous other minerals, in Orange and Westchester counties, New York, and Sussex county, New Jersey, and at various localities in Connecticut, Massachusetts and Pennsylvania. It is said by Dana to be common at many points along a belt extending from Virginia across western North Carolina and Georgia to Dudleyville, Alabama.

Oriental Ruby in Burma.

In Burma, which became a British Province in 1886, ruby mines have been worked for a very long period. There the country rock is chiefly gneiss, with bands of crystalline limestone of varying thickness and many miles in length. Most of the mining has been carried on in the hill-wash and alluvium carried down from the decomposed summits of hills and mountain ranges ; and it has been observed that where the sands and gravels are mixed with a dark brownish earthy clay, which is a product of the decomposed crystalline limestone, they are richer in such gems as ruby and spinel. The explorations of Barrington Brown appear, indeed, to have satisfactorily established that in Burma the only rock in which rubies are found in place is crystalline limestone. "It is of the usual composition and character of ordinary crystalline limestones," says Mr. Brown, "being made up of finely crystalline or granular limestone in layers, together with irregularly shaped bands of very coarsely crystalline limestone of white and bluish colors, which are interfoliated with the gneissic rocks." Where a quarry has been worked near Mogok, the matrix of the ruby is a coarsely crystalline, semi-opaque limestone of about twenty feet in width. The rubies are found over a space of six feet in width, extending almost vertically from the bottom of the quarry to the surface of the ground, and along the centre-line, where the rubies are most numerous, are small developments of a grayish diaspore enclosing small crystals of iron pyrites. As to the limestone itself, whether occuring as disseminated crystals through the gneiss or as great interfoliated masses, it is the opinion of Professor Judd that it has been neither organic nor due to direct chemical precipitation in its origin, but has resulted from a metamorphism of the lime-bearing felspars ; while during the process of change from basic felspar to scapolite, and from scapolite to hydrated alluminium silicates, and from these to alluminium oxide, "the slowly liberated oxide may assume the crystalline form, and thus give rise to corundum." Among other minerals found in the corundiferous limestone are pyrrhotite, hematite, apatite, graphite and spinel.

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[1] A paper read before the Canadian Institute 10 December, 1898.

[2] In the Burma corundum every shade of color, from white to the highly prized deep crimson or pigeon's blood, is found, and they are named according to colors instead of composition or system of crystallization—the red variety as oriental ruby, the blue as oriental sapphire, the yellow as oriental topaz, the purple as oriental amethyst, and the green as oriental emerald.

Corundum in Ceylon, India and China.

In Ceylon, in the peninsula of India, and in China there are numerous occurences of corundum in crystalline schists; and in almost every case the mineral is of the gem variety. As far as known to the writer, there are no deposits in Asia now exploited for use in the arts, saving the emery of Asia Minor.

Corundum and Emery in the U.S.

In the United States corundum is confined almost wholly to the region of the Appalachian mountains, along a belt that extends from New Jersey to Alabama. In the form of emery it is found at Chester, Massachusetts, in a chlorite belt about twenty feet wide, that lies between formations of hornblende-schist and talc, and traverses the mountains for about four miles. There is also a productive emery mine in Westchester county, New York, which ships from 500 to 700 tons of abrasive emery per annum.

Along the Appalachian mountain chain corundum is found in felspar veins and associated with chlorite in peridotite and serpentine rocks, in amphibolite, dunite and gneiss, as well as in gravel-beds. The principal deposits are found in association with magnesian rocks, chiefly peridotites, which occur as small lenticular masses in gneiss. As a rule however the corundum is neither in the peridotite nor in the gneiss, but in a narrow zone of chloritic minerals between the two. The largest known areas are in the southwestern counties of North Carolina, where corundum was first discovered in 1870. This state has furnished nearly all the corundum of commerce for the United States, but the statistics of the mines and works have never been published. There has been much waste of effort in mining for the gem varieties, encouraged by occasional discoveries, but chiefly by the attractive colors in which the corundum is found. The whole process of mining and milling has had to be learned by experience; and the task has been made difficult not only by the character of the formations, which is not favorable to sinking or drifting, but also by the closeness with which the corundum crystals adhere to the matrix.[3] For abrasive use it is very important that the corundum should be free from particles of rock or mineral softer than itself; and for use as an ore of aluminium it should be free from all impurities, to make extraction practicable by present methods.

Discoveries in Ontario.

By Dr. Sterry Hunt in Burgess.

The first discovery of corundum in Ontario was made by the late Sterry Hunt fifty-one years ago, in the second year of his connection with the Geological Survey of Canada. Dr. Hunt explored part of the county of Lanark in 1847. He was joined in some of his excursions by Dr. Wilson of Perth, who at that time enjoyed local reputation as a geologist (the mineral wilsonite is named after him), and who is still remembered as a man who paid considerable attention to the natural history of his district. The first place visited by them was the fourth lot on the eighth range of the township of Burgess, upon which Dr. Wilson a short time before had discovered a body of apatite. Near by, on the second lot of the ninth range, was a deposit of copper pyrites in crystalline limestone, and this was also visited. The only exploration work consisted of two or three blasts, and among the masses of rock thrown out were some composed of silvery mica, with quartz, felspar or albite, and calcspar, holding a delicate emerald-green and almost transparent pyroxene of rare beauty, as well as crystals of a dark honey-yellow sphene. The mica was often aggregated in masses of small crystals, having

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[3] Mr. Alexander Rickard of New York, who is owner of a corundum property at Energy, in York county, South Carolina, says in a letter to me of recent date: "All our corundums are very difficult to clean. While the gangue is soft, it is tough, and adheres to the grains of corundum when it is broken up. This reduces the cutting value, and also creates trouble by fluxing when making into wheels."

nar arrangement,[4] imbedded in which,
;eminated throughout the rock, were
number of crystalline grains of a
rent mineral, varying in color from a
se-red to a deep sapphire blue. Dr.
n his report to Sir William Logan,

ir hardness, which is so great as to
them to scratch readily the face of a
of topaz, showed them to be nothing
n the very rare mineral corundum,
from its colors is referable to the
s known as oriental ruby and sapphire.
ins obtained were small, none indeed
han a pepper-corn ; but at the time I
the spot they were not noticed, and
imens were collected for the pyrox-
only two or three of which I have
tected the corundum. It is probable
ther examinations may develop larger
re available specimens of these rare
stly gems. It is in this crystalline
ne that they generally occur, and the
m found in the State of New Jersey
e same rock and with similar mica."[5]
t does not appear that this discovery
gess received further attention from
r other members of the Geological
and the mineral was practically re-
red there a year ago by Professor
of the Kingston School of Mining.
be seen from Hunt's account that
cimens were collected only for their
e, and that the crystals of corundum
t noticed or identified until a later

By Henry Robillard in Raglan.

The largest known deposit of corundum in the Province was discovered twenty-two years ago on the farm of Henry Robillard, in the township of Raglan, Renfrew county ; but in this case twenty years elapsed before the mineral was correctly identified. According to Robillard's story, he was returning with his little daughter from a cranberry marsh on the wide flats of York river, and in climbing a hill which rises about 500 feet above the river, he sat down upon a large boulder to rest. In telling me the story Robillard said : "Annie was kneeling behind me, and picked up a queer-shaped stone, and, showing it to me, said it looked like the stopper of a cruet-bottle. It was just like that ; and I wondered what fool of a man had gone to work and whittled it out. Then I looked at the stone where I was sitting ; and, bless you, sir, it was paved with cruet-stoppers. And here is the very boulder now," he added, as we reached the spot, about half-way down the hill.

Specimens gathered by Mr. Robillard were shown to several persons in Combermere, and one who professed to be a miner of phosphate of lime in Lanark county pronounced them to be crystals of that mineral. In 1884 one John Fitzgerald joined with Robillard in an application to the Crown for the mineral rights on the property, including several lots on the 18th and 19th concessions of Raglan ; and for a number of years they sought in vain for a customer to buy an apatite mine. The sturdy pioneers would brook no contradiction of their claim that the mineral was veritable apatite ; and when a doubt was raised by two young mineralogists who visited the region about ten years ago in the interest of a capitalist, and a suggestion was meekly made that it might be emery, one of the pioneers cut negotiations short by threatening to "punch their heads." Last year, however, these pioneers were overjoyed to learn on the authority of an expert that the mineral was not apatite, but corundum.

Twelve years ago, in 1886, Nesbitt T. Armstrong, a farmer and mill-owner in Carlow, discovered corundum on lot 14, in the 14th concession of that township, but he did

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not improbable that these were decom-
altered crystals of corundum. On the
rphosis of the mineral Professor Judd
'At the earth's surface, as is well-known,
m or the crystallized oxide of aluminium is
the most unalterable substances. Frag-
und in river gravels and sands, though
water-worn, show no trace of chemical
n in their surfaces. On the other hand,
n be no doubt that conditions must exist
rth's crust under which chemical change
ineral does take place ; this is abundantly
y the frequency with which undoubted
orphs of corundum occur. Among the
found replacing corundum as pseudo-
re muscovite (damourite), various forms of
ndalusite, fibrolite, cyanite, margarite,
d, zoisite, ripidolite and other chlorites,
ermiculites, kaolin, and other substances."

Sur. Can. 1847-8, p. 134.

By N. T. Armstrong in Carlow

not know its name, and did not suspect that it possessed any value. A sample was shown to a student of Toronto University, who thought it might be emery, and inquiry stopped there. But in 1893 Mr. W. F. Ferrier, lithologist to the Geological Survey, acquired by purchase a number of specimens collected by Mr. John Stewart, formerly of Ottawa, among which was a package labelled "Pyroxene crystals, south part of Carlow." On examining these specimens some time afterwards presumably in 1896, Mr. Ferrier recognized them as corundum, and immediately took steps to ascertain the precise locality from which they came. In October, 1896, he was sent upon this mission by Dr. Dawson, the head of the Geological Survey, and, guided by Mr. Armstrong, he found the corundum in place upon the lot on which Armstrong's discovery had been made ten years before. Then for the first time the fact was established, on the best authority, that this mineral had been found to exist in Canada in commercial quantity, and that it was valuable as an abrasive material on account of its great hardness. But as it was too late in the season for field-work, Mr. Ferrier did not extend his explorations beyond that one locality.

By Dr. Coleman in float Boulders.

Eleven years ago Professor Coleman, now of the School of Practical Science at Toronto, picked up some boulders of nepheline-syenite in the vicinity of Cobourg, on the shore of lake Ontario, which held crystals of corundum. A fortnight ago I showed Dr. Coleman several specimens of nepheline, rich in cornudum, which I had taken from a large deposit recently discovered in the township of Dungannon, and he at once pronounced them to be identical with his own. "I feel sure now," he said, "that I know where my float-boulders came from."

Geological Reconnaissances.

By Alexander Murray

The first geological reconnaissance of the district in which corundum has been found was made by the late Alexander Murray, of the Geological Survey, in 1853; but his notes of it are very meagre. Mr. Murray made two traverses of the country lying between Georgian bay and Ottawa river—the first from west to east, by way of the Muskoka and Petewawa rivers, and the second by way of the Bonnechere and Madawaska, to the headwaters of the Trent. The source of the Bonnechere is within a mile of Kaminiskeg lake, on the Madawaska, near to where Barry's Bay station now stands, on the Ottawa and Parry Sound Railway. Mr. Murray descended the Madawaska to the mouth of its principal tributary, the York branch, or York river; known also at that time by its significant Indian name of Shawashkong, or Mishawashkong, the river of the marshes. The course of the stream, which Mr. Murray ascended, lies for more than forty miles within the corundum belt; and along its banks are numerous exposures of syenite, with occurrences of nepheline syenite. But no reference is made in the report to the rock formations [6]; and the record of levels for the first ten miles is of very doubtful accuracy.

By Dr. Frank D. Adams

Forty years elapsed before another attempt was made to work out the geology of this interesting area, and the task was then entrusted to the very capable hands of Dr. Frank D. Adams. The area under examination is comprised in sheet 118 of the Ontario series of geological maps, and the four corners of it lie in the townships of Digby, Finlayson, Hagarty and Grimsthorpe respectively, embracing an area of about 3,500 square miles. In his first report, made for the season of 1893, Dr. Adams sketched briefly the geological features of the district, the northern portion of which he found to be occupied exclusively with the ancient crystalline rocks of the Laurentian system, and the southern and eastern portions with the limestones and gneisses of the Grenville series. "The discovery of so large an area of the Grenville series in this district," Dr. Adams says in his report, "is most encouraging, as indicating the probable occurrence in it of large and valuable mineral deposits." An extensive and remarkable mass of nepheline syenite was discovered in the townships of Faraday and Dungannon, which was traced for a distance of over seven miles in an east and west direction. Dr. Adams says:

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[6] **The rock formations along the York river however are carefully noted on the maps which accompanied the report, as are also the waterfalls and rapids of the river from its mouth to its source.**

"This is a rare rock, found in but few places in the world, and never before discovered in our Laurentian system. The nepheline is very abundant, forming in many places an almost pure nepheline rock. The mass is flanked on the south, along a considerable part of its course, by crystalline limestone, and it is also intimately associated with a fine-grained reddish rock, resembling aplite. It is of a prevailing gray color, and often has a distinct foliation, coinciding with that of the associated rocks."

The beautiful blue mineral sodalite was also found in a number of places, associated with the nepheline syenite, in the form of veins and irregular masses; but no occurence of corundum was observed

By Barlow and Ells.

During the past three seasons Mr. Barlow has been associated with Dr. Adams on the work of this field, and a very interesting and valuable report may be confidently looked for upon some of the most intricate questions of Archæan geology. Dr. R. W. Ells has also been engaged at intervals in surveying portions of the Ottawa valley east of the area on which Messrs. Adams and Barlow have been working, into which the corundum belt is known to extend as far at least as the Ottawa and Opeongo road. The two map-sheets however, as well as the accompanying reports, will deal with the general geology of the districts, and notwithstanding the importance of the corundum discovery it is not likely that prominence will be given to that subject, if the usual practice of the Survey is followed.

Recent Exploration Work.

Prof. W. G. Miller's Reports.

During the last two seasons Professor W. G. Miller of the Kingston School of Mining has been employed by the Ontario Government to make a special report on the field. Beginning last year with the study of the occurrence of the mineral at the place of first discovery in Carlow, he has been able to trace the corundum-bearing rocks eastward across that township, through Raglan and Lyndoch, to the shores of Clear lake, near the eastern line of Sebastopol, a length of about 30 miles. The breadth of the band varies from half a mile to three or four miles, and its total area embraces about 60,000 acres. The prevailing country-rock of the district is gneiss, composed chiefly of hornblende, biotite and felspar, and it is probably an altered gabbro. Numerous dikes or masses, consisting largely of felspar, cut through the older rocks, which sometimes have the character of coarse syenite, passing in places into nepheline syenite. In both of these rocks corundum was found, as well as magnetite, pyrite, garnets, zircon and sodalite. In continuing his work this year Professor Miller has succeeded in tracing the syenite band continuously for about 75 miles. from the township of Glamorgan in Haliburton to the township of South Algona in Renfrew, besides tracing it to a considerably greater width over the region explored last year.

An extensive Area traced out.

Corundum was found at a number of places in the western part of the belt, and a large and apparently rich deposit in a ridge of nepheline syenite near the middle of it in the township of Monteagle. But as the rocks over nearly the whole of their extent are covered with sand, it is probable that many valuable deposits remain to be discovered. The total area of this band is about 300 square miles; and, as it lies in a Free Grant district, the mineral rights are reserved by the Crown in almost all the lots that have been taken up for settlement. In a few cases, where lands were sold more than thirty years ago, the mineral rights went with the surface rights, and since that time some lands have no doubt been sold or leased as mining lands. But it is safe to say that the Crown holds for disposal the minerals in at least 90 per cent. of the whole tract.

Two years ago corundum was found in a property that was being worked as a mica mine in the township of Methuen, in Peterborough county, about 45 miles southwest from the original discovery in Carlow. This locality has also been explored by Professor Miller this year, and the corundiferous band of syenite has been traced in a northeast and southwest direction about six miles, with a width of two miles. The range of hills over which it extends is known locally as the Blue mountains, and at its southwest end it reaches the shore of Stony lake.

A Tour of the Corondum Belt.

From Sebastopol to Bancroft.

I spent the last week of September with Professor Miller in going over the more northerly band, from the easterly end of it on Clear lake, in Sebastopol, to the village of Bancroft on the Hastings road, on the line between Dungannon and Faraday. Only a few of the principal properties were visited, including the Block location in Brudenell, the Robillard location in Raglan, the Armstrong location in Carlow, and a recent discovery in Monteagle, not far from the York river. All these are large deposits, easy of access, and favorably situated for mining operations.

On the Block Farm.

Where the exposure occurs on the Block farm the crystals are in syenite, and are thickly studded in the face of the rock. Outcroppings of nepheline syenite occur near by; and, owing to its resemblance to limestone, an attempt was made by the owner to burn it for lime. The crystals of corundum have a bronze lustre, and vary in size from half an inch to an inch in diameter. Numerous boulders are strewn over the face of the ground which carry a high precentage of the mineral, and in some cases the crystals are nearly pure white in color.

On the Robillard Hill.

On the Robillard hill corundum may be traced for a mile or more along its southern face, wherever the syenite is exposed. The corundum crystals are frequently observed to run in strings several inches wide along the surface of the rock, and are of all sizes from half an inch to two or three inches in diameter, usually barrel-shaped, and ranging from an inch to four or five inches in length. On the western shoulder of the hill there is an outcrop of nepheline syenite; and in this rock the crystals are finely shaped, but of small size—about a third of an inch in diameter and an inch or an inch and a half in length. An expert who has examined this hill estimates the corundum in sight at several millions of tons. There is certainly a large quantity, and in some places it amounts to from 30 to 40 per cent. of the rock mass. Along the foot of the hill are numerous large boulders of syenite, speckled over with crystals like plums in a pudding.

On the Armstrong Lot.

The Robillard hill is cut off by a stream upon its west side from a range of high hills that extends westward five miles into Carlow. Professor Miller has carefully examined this range, and has discovered corundum in it at a number of points. The largest showing however is on the Armstrong lot, where another stream cuts through on its way to join York river. The rock has scaled off so as to show a perpendicular face about 300 feet in length and 30 feet in height, exposing a mass of syenite which has been thrust up through the gneiss, and which in its turn has been cut by a dike of pegmatite. The gneiss has been thrown up to form an anticlinal arch over the syenite, but is cut through along the north side, where the syenite dike is well exposed with a thickness of ten or twelve feet. According to Mr. Ferrier it has been traced along the strike about 700 feet. Crystals of corundum are numerous on the exposed face of the syenite, and are also found in the pegmatite nearest the syenite, which is composed chiefly of felspar. But where quartz comes in with the felspar the corundum disappears. A lot of several tons, taken without selection from this location last year and treated at the Kingston School of Mining, yielded from 12.75 to 15.5 per cent. of corundum.

In the Township of Monteagle.

The last location I examined is in the township of Monteagle. It is in a ridge of nepheline syenite, having a width of 90 to 100 feet, and rising upon one side to a height of about 60 feet. My time only permitted me to follow it for a length of about 150 yards, but Professor Miller informed me that he had traced it for half a mile. The whole surface, as far as I examined it, was thickly strewn with small crystals of corundum, ranging in color from pearl to blue; but here and there parts of it were altered into white mica. A sample of for me under the direction of Dr. :arried nearly 10 per cent. of and was remarkably free from)re of this character ought to be for the production of aluminium. s the nepheline itself, the gangue ns about 30 per cent. of alumina.

:onomic Uses of Corundum.

nay be remarked that, owing to ce of iron and other impurities, iakers of aluminium assert that orundum is unsuited for the roduction of that metal. But it ;eep an open mind on subjects of . When one reflects that by the : new and improved processes the oducing aluminium has been rein forty years from its weight in :ents per pound or less, one ought me that it is impossible to find a producing pure corundum at low a process to make aluminium out re ore. Professor DeKalb of the School of Mining was able last th a small experimental plant, to undum (99.61 per cent. pure) from arried five per cent. of magnetic What then might be expected e and well-equipped plant, capable 50 to 100 tons per day, supplied device that the wit of man can inespecially with a good quality of rk upon ? In one particular the neral appears to differ from the the Appalachian belt ; the gangue nd is easily broken up and separ- he corundum.

rtainly add greatly to the value of um deposits of Ontario if they can producing aluminium as well as al for abrasives, if the history of during the last ten years is a fair future. In the ten years ending ts production in the United States om 19,000 pounds, valued at $3.42 , to 4,000,000 pounds, valued at er pound ; and so much progress a time seems to be ample justifi- he statement of Professor Richards years ago in the preface to his valuable book on Aluminium : "The abundance of aluminium in nature, the purity of its ores, its wonderful lightness and adaptability to numerous purposes, indicate that the goal of the aluminium industry will be reached only when this metal ranks next to iron in its usefulness to mankind."[7]

Probable occurrence of Gem Varieties.

None of the discoveries hitherto made in Ontario seem to encourage the hope that gem varieties of the corundum are to be found, although in some localities an occasional crystal is to be seen with qualities not unlike sapphire, being semi-translucent and of bluish color. Perhaps if search were made in the crystalline limestones it might be awarded with better success ; not that corundum of any quality has yet been found in the limestones, but because their relations to the gneiss are not dissimilar to those which obtain in Burma. When the source of the limestones has been worked out, it may be shown that, like those of Burma, they heve been derived by metamorphosis from the felspar of the gneiss, or perhaps from the felspar of the syenite ; and if so, the analogy would suggest that these rocks are worth prospecting for corundum in some of its more valuable forms. In a note received from Professor Miller on this subject he says :

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[7] **Aluminium: Its history, occurrence, properties, metallurgy and applications, including its alloys. By Joseph W. Richards, A.O., Ph. D., Instructor in Metallurgy at the Lehigh University. Third edition. At page 474 Prof. Richards says :**

"It does not withstand chemical agents in general as strongly as the noble metals, but it withstands air, water, sulphuric acid, nitric acid and sulphuretted hydrogen—which is not the case with iron, copper or even silver. We have then a semi-noble metal ; but while silver, gold and platinum have extremely small prospect of becoming noticeably cheaper, yet the time is probably not far distant when we shall have our semi-noble metal at the price of the base ones. This affords the immense future for aluminium. Whatever its price, it can only replace gold or platinum because of its lightness ; it already replaces silver especially because of its resistance to sulphur, as well as for its lightness, besides being cheaper ; it can only replace the common metals at its present price for uses where its lightness is an extraordinary advantage. But when its price is down to that of these baser metals, it will begin to replace them by virtue of its other superior qualities, chemical and physical ; aside from its lightness it will win a large field simply in comparison with them on its merits as a metal. Thus there are wide applications now almost unthought of, because the high price has been a blank wall to stop its use ; but as it cheapens more and more, we hear every day of new uses brought to light. Thus its sphere will widen until, since its ores are as cheap as those of iron, it will approximate in utility to that universal metal. At the time of this writing (1895) there are only four metals which are cheaper bulk for bulk than aluminium, viz.: iron, zinc, lead and copper ; and the amount of aluminium produced yearly is increasing much more rapidly than any of these. Aluminium has therefore already won its place among the common metals of every-day life. It will, of course, be many years before it outstrips any of these, but I believe the ultimate goal of aluminium industry will be reached only when it stands next in importance and value of annual production to iron. From this time forth every year will see substantial advance towards this goal, and the next century may see this end attained."

"It is quite possible that corundum may yet be found in considerable quantity in crystalline limestone in Ontario, as in India and Burma. In India the mineral occurs under various conditions in metamorphic (limestones, etc.) and igneous rocks. Of course there need be no connection between the occurrence of the mineral in these two classes of rocks. If corundum occurs in our crystalline limestones, it is of a different origin from that occurring in the igneous rocks (the syenites)."

The crystals discovered by Sterry Hunt in Burgess, it will be remembered, were found in association with pyroxene in crystalline limestone.[*]

Scheme to Establish a Home Industry.

Regulations governing the disposal of Corundiferous Lands.

In view of the extent and apparent richness of the corundum fields in the Province, the Government has taken steps aimed at developing the deposits and establishing a home industry. Regulations have been drawn up under which the mineral rights in lands lying within the two corundiferous belts have been withdrawn from sale, and hereafter the mineral and mining rights in such lands can be acquired only under the leasehold system. Instead of allowing speculators to take up and hold lands with a view to sell out their interests to miners and capitalists at a large profit, it is proposed that the advantage of acquiring lands upon the lowest terms shall go to the miner and manufacturer direct ; and in the case of parties who will undertake to conduct mining and treating operations on the largest and completest scale, and who can furnish satisfactory assurance that they possess the requisite capital for the proposed operations (including separation of the ore from its gangue, milling for abr
manufacture of abrasive goods, a
duction of aluminium), the Gover
concede a preference in the s
mineral lands. It is also provid
Government shall have power to r
all corundum mined from lands le
the Regulations shall undergo c
cesses of treatment and milling a
be erected in the Province to pr
market ; and may further requir
to time, as circumstances appear
that works be established in the P
the manufacture of all useful or
products for which the mineral
economically adapted.

Text of the Regulations.

is the text of the R
which were adopted by Order
July 4, 1898 :

1. All corundum-bearing lands the min
which have been already or may be hereaf
from sale or lease, or in which the mining
may be otherwise reserved by the Crown, sh
the general provisions of the Mines Act, ex
provided, be disposed of under the leasing
the said Act, and shall continue to be hel
lands only.

2. During the first period of ten years t
expend in stripping or in opening mines, in
or in other actual mining operations, or
otherwise treating the ore or mineral taken
location to prepare it for the market, exclusi
houses, mills, machinery and other like im
sum not less than at the rate of one dolla
year ; and where an area of not more than
sisting of two or more separate lots or locati
the same person, partnership, syndicate
within a block of 4,000 acres or two and o
miles, the whole value of the mining opera
to be done in one year may be expende
location at the discretion of the lessee, and
additional 640 acres or fractional part th
same person, partnership, syndicate or com
within the same block.

3. In the event of failure on the part o
carry on mining operations as required in
section in each and every year of the fir
years the lease shall forthwith cease and d
all interests of the lessee in the land or lar
to the Crown : nevertheless it shall be com
lessee to prove that during one or more pre
the term the extent of mining operations
been adequate to cover the requirements f
default, in which case the lease shall not be
the lessee may also defeat forfeiture by a
with satisfactory security to expend th
required for working conditions within the
ing year, including the expenditure in defa

4. At the expiration of the first term of
be renewed for a further term of ten year

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[*] Since this paper was written specimens of crystals very closely approaching sapphire gems have been found in Hastings, occurring in a narrow outcrop of syenite lying between two bands of crystalline limestone. Some are in nests, and others in isolated crystals.

rental and under the same working requirements if the covenants and conditions have been performed and fulfilled, and thereafter it may be renewed for successive terms of twenty years on such conditions and at such rent as the regulations may provide.

5. The person, partnership, syndicate or company to whom the mining rights may be awarded of any lands which have been located or sold under the Free Grants and Homesteads Act, or sold for agricultural purposes, shall compensate or settle with the owner or locatee of such lands for injury or damage done or to be done to the surface rights thereof before beginning work thereon, and if the parties fail to agree upon the amount or method of compensation, the Director of the Bureau of Mines shall have power to order and prescribe the same.

6. The Lieutenant-Governor in Council shall have power to fix and determine the maximum price at which corundum taken from lands leased under these terms and conditions may be sold for use in the Dominion of Canada, whether the ore or mineral be in the natural state as raised from the mines or in any stage of treatment or manufacture.

7. The Lieutenant-Governor in Council shall also have power to require that all corundum mined from lands leased under these terms and conditions shall undergo certain processes of treatment and milling at works to be erected in the Province to prepare it for market; and may further require from time to time, as circumstances appear to warrant, that works be established in the Province for the manufacture of all useful or commercial products for which the mineral or ore is economically adapted.

8. The Commissioner of Crown Lands may receive tenders for mining lands and mining rights in the explored belt to the 15th day of September, 1898, which tenders shall be in the form of a cash bonus to be paid to the Treasury for each lot, part lot or location applied for in addition to the first year's rental; but in considering the bonus so tendered for a lot or location, preference in the selection of mineral lands may be given to parties who will undertake to conduct mining and treating operations on the largest and completest scale, and who can furnish satisfactory assurance that they possess the requisite capital for the proposed operations—including separation of the ore from its gangue, milling for abrasive uses, manufacture of abrasive goods, and the production of aluminium.

Postscript.

Agreement to establish Works for treating and manufacturing Corundum.

Only one substantial tender was received under the terms of the foregoing regulations, but an agreement upon all details was not reached until 15th September, 1899, when a contract was entered into with the Commissioner of Crown Lands by Joseph N. Shenstone and B. A. C. Craig of Toronto. This agreement provides for the acquisition by the lessees, subject to the provisions and regulations of the Mines Act and the Water Powers Act, of the lands for which application had been made (not to exceed in the aggregate 2,000 acres) and two water powers on the York Branch of Madawaska river in the township of Dungannon. It also provides that they shall form a joint stock company for the better carrying out of the terms of the agreement, with a minimum capital of $250,000. Such a company has now been organized and chartered, with the title of The Canadian Corundum Company. The agreement further provides for an expenditure of $100,000 before 1st July, 1902, for the following purposes, viz:

1. Acquiring from the Crown the mining leases of corundum properties.
2. Stripping and development of corundum properties and the production of grain corundum or other materials therefrom.
3. Development of electrical or other energy necessary to furnish motive power for machinery and works.
4. Erecting within Ontario a plant with capacity sufficient to treat not less than one hundred tons of corundum-bearing rock per day, together with factory, buildings, kilns, etc., and the installation of full machinery for the production of manufactured goods from corundum, and construction of necessary roads and tramways.

For these purposes an expenditure of $25,000 is required to be made before 1st July, 1900, and $50,000 before 1st January, 1901, and out of the whole of $100,000 not less than $25,000 is required to be expended for the objects enumerated in No. 4. In the event of corundum being found adapted to new uses, the lessees agree to expend such further sums as may be necessary for the full development of such uses. They also agree to expend $1,000 per year for three years for the purpose of making a series of experiments, to discover some method or methods for the production of materials of commercial value from corundum-bearing rock other than grain corundum, special attention to be given to the production of the metal aluminium, and on 1st July of each year to furnish the Government with a confidential report of progress. A bond in the sum of $5,000 has been given as security for performance of the terms of the agreement.

CORUNDIFEROUS NEPHELINE SYENITE

By Dr. A. P. Coleman

A considerable area of nepheline syenite was discovered about six years ago in Dungannon township, Hastings county, by Dr. F. Adams, who described the rock briefly in his Report on the Geology of a portion of Central Ontario, and more fully in the American Journal of Science.[1] In 1896 corundum was found in the same region by Mr. W. F. Ferrier, and in the following year Professor W. G. Miller was instructed by Mr. Archibald Blue, Director of the Bureau of Mines, to examine and report upon the corundum-bearing rocks. In the course of his work it was found that the corundum occurred not only in ordinary syenites, but also in nepheline syenite.[2]

Discoveries of Nepheline Syenite and Corundum.

In November, 1898, the present writer examined an outcrop of the latter rock for the Bureau of Mines on York Branch of Madawaska river near the northeast corner of Dungannon township, or just within Monteagle, several miles from Dr. Adams' localities, and presenting a number of new and interesting features. The rock forms a ridge running nearly north and south for about 350 yards, with a width of about 20 yards, and having a well defined schistose character, so that at first sight it would be called gneiss It is light to dark gray in color, the darker layers containing much biotite, the lighter ones more nepheline and plagioclase. On much of the weathered surface numbers of small crystals of corundum stand out, having resisted weathering better than the other constituents. In hand specimens of the unweathered rock however the corundum is scarcely noticed, and the rock has quite the appearance of fresh gray gneiss, the nepheline looking like quartz. Near the southern end of the ridge an irregular dike a few feet wide crosses the gneissoid rock, reminding one of pegmatite. It is white and consists of immense individuals of nepheline and muscovite, often several inches or even a foot long, with small patches of blue sodalite. No felspar was seen in the dike, unlike samples described by Adams, and no corundum was found in it.

The Deposit in Monteagle.

Variations in the Nepheline Syenites.

As usual in nepheline syenites, there is great variation from point to point in the rock, easily seen on weathered surfaces and still more marked in thin sections. Adams finds, as essential ingredients of the outcrops near Bancroft, nepheline, plagioclase, and biotite or hornblende in small amounts ; but scapolite and calcite usually occur, as well as various minor accessory minerals. Thin sections from the locality here described show more variety in constitution. All the minerals mentioned occur except hornblende, and the felspars include orthoclase and also a little microline as well as microperthite. The soda-lime felspars are generally present in much larger amounts than the potash felspars, and seem to have a wide range in composition as determined by optical means. A few have angles of extinction of 4° or 5° from the twin plane and appear to be albite, as in the rock examined by Adams ; others having a very small angle are probably oligoclase, while a considerable number range from 17° to 23°, indicating labradorite. Some have broad and sharply cut twin lamellæ, others very narrow and obscure ones. All the felspars are beautifully clear and fresh as a rule, much more so than those of the associated Laurentian gneisses and granites.

Constituents of the Rock.

The nepheline also is generally very fresh and, as mentioned by Adams, has not the color nor oily luster of eleolite, though it seldom shows crystal forms. Large individuals often contain inclusions, minute crystals of hornblende, of biotite, and long rows of

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[1] Geo. Surv. Can. 1892-3, part J, p. 5; Am. Jour. Sci, vol. XLVIII, July 1894, pp. 10-18.

[2] Bur. Mines, vol. VII, pp. 210-212.

f a transparent doubly refracting
Calcite inclusions sometimes occur
enclosed in fresh looking nephe-
one example the somewhat weath-
eline contains crowds of slender
it fibers or somewhat bent cords,
ittle the look of apatite but with a
e of extinction, perhaps tremolite.
ly decomposition products occur
ures, having the appearance of
without any distinct structure.

e is found in about a third of the
ometimes almost to the exclusion
colorless ingredients, and has the
primary mineral. Its anhedra meet
ing felspar or nepheline in a sharply
ay, with no hint of weathering in
minerals. Muscovite is a very
constituent of these rocks, being
nore than half of the thin sections
, generally as large primary look-
iduals, sometimes associated with
ough often without it. Biotite is
y the only dark mineral in the rock,
le not having been observed. As
ecimens examined by Adams it is
in color and has a very small axial
ugite was found as small blue-green
n one section only. Magnetite was
l, and apatite was rare.

st interesting accessory mineral is
, which sometimes occurs in fairly
well formed barrel-shaped crystals
half an inch in length, but is usually
nd often forms only minute rounded
Its color is gray or, less often, pale
Owing to the hardness of corundum
ind difficult to prepare sections rich
s, and only two have been studied.
e microscope their high refractive
l greater thickness than the rest of
on cause the corundum grains to
t sharply. They are apt to be ar-
clusters in association with musco-
n completely enclosed in it.

gh the rock here described has a
rked schistose structure, there is
n its microscopic characters to sug-
ring or crushing, no mortar struc-
granulation, and seldom even undu-
tinction to hint at a state of strain.

The rock as a whole is hypidiomorphic granular, and except corundum none of its constituents show much tendency to crystalline form.

The coarse-grained dike with its individuals of nepheline half a foot wide is not easy to study in thin sections. The nepheline proves under the microscope to have been slightly fractured, very narrow fissures being filled with a rather brightly polarizing mineral, perhaps felspar. The few inclusions are much like those of the nepheline in the schistose rock, but in one section rather large portions of muscovite are enclosed. The large crystals of pale lavender muscovite have no unusual characters, except their often perfect idiomorphy as against nepheline and sodalite. The crystals are not hexagonal in cross section, but four sided, having one angle of about 60°. The basal cleavage is somewhat inclined to the prismatic edges, though a series of pyramids having a very long C axis makes it difficult to determine the angle. In thin sections cut across the cleavage this muscovite has an extinction angle of 3° to 5°.

Distinct types of the Rock.

If single thin sections were to be diagnosed alone four quite distinct types of rock could be described from this outcrop: a nepheline-muscovite rock; a rock made up chiefly of scapolite and muscovite with a little biotite, plagioclase, and nepheline; a rock containing about equal parts of plagioclase and nepheline with some mica, and a rock consisting of orthoclase, microcline and nepheline with some mica. There are however transitions between these varieties, and it would be unwise to split up what is so evidently a geological unit into rocks of different names when the whole is so well defined in general character, though each hand specimen shows differences from its neighbors.

Alumina a prevailing Constituent.

No analysis has been made of this rock, but one specimen yielded nearly 10 per cent. of corundum in a heavy solution. As there was no magnetite nor other heavy mineral present the separation was very complete, corundum having a much higher specific gravity than the other ingredients. Since every mineral present, except the trifling quantity of calcite and apatite, contains alumina, nepheline in particular to the extent of more than 30 per cent., this oxide must occur in very large amounts. On the other hand iron oxides must be very low, since the only iron-bearing constituent is biotite.

Specimens from Other Localities.

From Lancaster's farm in Dungannon.

A specimen of nepheline syenite was obtained from Lancaster's farm, some miles southwest of the locality just described, from a small outcrop showing no schistose structure. It is coarser grained, but of the same color and general appearance as the rock from York Branch. Thin sections show however that it has been subjected to shearing forces, since there is a granulation round the larger pieces of felspar and nepheline suggesting mortar structure. Nepheline is present in large amounts, and also a peculiar type of microperthite having long fibrous looking inclusions of one felspar in another, the main mass being in parts very finely striated (anorthoclase ?) with twin lines making an angle of about 23° with the most marked cleavage. Oligoclase and biotite occur in smaller amounts, the latter as usual very opaque. Some of its outer scales weather to a bronze-brown color, are dichroic, and have the optical axes much farther apart than in the fresh mica.

From Methuen in Peterborough.

Specimens of a medium-grained white rock dotted with darker minerals come from a locality not visited by the writer, in Methuen township, Peterborough county, and are interesting as containing many dark brown corundum crystals having a bright bronze lustre on basal partings, as well as minute crystals of magnetite. Thin sections of one specimen disclose chiefly plagioclase, finely striated and with a low angle of extinction from the twin plane ; a little microcline, nepheline and muscovite making up the rest of the rock. Sections of another specimen very similar in appearance contain more muscovite and a large amount of nepheline, or rather of a turbid decomposition product, confusedly scaly or fibrous. having high double refraction. The mineral seems to have parallel extinction, fuses readily without intumescence to a white glass, and gives water in the closed tube, so
that it is no doubt a uniaxial or
zeolite, perhaps natrolite. The coru
very opaque, so that only minute par
crushed crystals can be studied satisf
It contains many inclusions of two
slender black needles lying parallel
another, and brownish red strips and
somewhat irregularly shaped and
The latter are probably hematite, a
duce the bronze lustre seen on basal
of the corundum. Extinction is par
the needle-like inclusions, and the
rather strong dichroism, violet wh
needles are parallel to the chief sectio
lower nicol and reddish-brown in th
site position. Some fragments, no
parallel to the basal plane, are not di

The first of the two specimens m
named a plagioclasite (anorthosite co
more basic felspar) if taken separat
the second does not differ from typ
amples of the York Branch nepheline
except in the completo weathering
nepheline, and probably both are
forms of the same rock mass.

From Raglan in Renfrew.

Through the kindness of the Dir
the Bureau of Mines specimens of co
rocks from Raglan town
Renfrew county, about
miles northeast of Dungann
been placed at my disposal. One is
somewhat schistose, and much li
Methuen specimens except that it
biotite, and that the pale greenish co
crystals are almost an inch in diame
have no bronze shimmer on basal
Under the microscope it is found to
mainly of plagioclase (oligoclase) and
the latter pale greenish-brown, fai
chroic and with a small axial angle. T
also a few large patches of colorless
vite having a large axial angle. Th
men has the mineralogical compositi
diorite, though of a very unusual ch
but Professor Miller states that n
syenite occurs close by, apparently
the same rock mass, though not so
corundiferous.[3]

These white rocks were taken for li
by farmers of the region, and an

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[3] Bur. Mines Rep. 1897, p. 222.

e to burn them for lime, of course in and specimens, partly fused, were om the kiln and supposed to be e-syenite, many of them doubtless at composition ; but the one pro- r microscopic examination contains eline. It is evidently part of a and is schistose and pale gray to the surface, but mottled bright blue e where broken. Under the micro- rock is found to consist of scapolite, and biotite, with a very little ortho- he scapolite forms the greater part ck, the spaces between its anhedra led with sodalite ; the latter blue out when in small portions, but only dges when in large ones, the centre lorless and isotropic. The boulders by Miller to be blue only after being the lime-kiln. The biotite is deep n in color, has a high absorption and axial angle, perhaps the result of ; just as many dark biotites turn y weathering and have a wider angle the optical axes. There are small es of an unknown mineral present, ransparent and having a low double n, so as to give only dull blue or ints between crossed nicols. Two or ctions of it show an axial image con- f a black cross opening out about as many biotites, but without colored It is optically positive.

eleven years ago the writer collected erable number of specimens of nepheline-syenite from drift boulders t in the neighborhood of Cobourg, which lies about south-southwest of the localities referred to above and ty to a hundred miles distant from At that time nepheline syenite had been reported from the Province.[4] eral way these specimens correspond arance and composition to those e been described, though a number tional minerals occur in them, the portant being hornblende, augite and both of the ordinary kind and melan- brown variety. Only one of the ns collected then contains corundum ; and it, though closely like the others in appearance, shows little or no nepheline and resembles in mineralogical constitution one of the specimens from Methuen. The purplish-gray corundum crystals are quite large, and thin sections show the same needlelike inclusions and dichroism as the Methuen crystals, but not the hematite plates. As there is not much doubt that the Cobourg drift boulders originated in the nepheline syenite region to the northeast, they have been referred to here and may be considered in connection with the rocks previously described.

Uniformity in Variety.

Qualities in common exhibited in Types.

In spite of the great variations in mineralogical composition to be seen in hand specimens, all the rocks referred to have much in common : they are white to gray in color, generally schistose, often corundiferous, and present the same general habit, so that in field work they are naturally thrown together as nepheline syenite and can be sharply distinguished from adjoining Laurentian gneisses, granites and syenites. While not all of them contain corundum in large amounts, they serve as a general guide to the discovery of the corundiferous rocks, and are so used by prospectors for that mineral. Some of the ordinary syenites of the region however contain corundum also, and the largest crystals found occur in them.

Just why the magma which has solidified into the group of rocks described above should be so versatile in regard to mineralogical composition is not easily explained ; but no other rock known to the writer shows so great a variety of types within short distances as may be found in the nepheline syenites. It may be that experiments such as those of Morozewicz[5] will give the clue to this variability, which seems to depend on the large proportion of alumina in the original magma. The corundiferous varieties of nepheline syenite represent magmas supersaturated with alumina but not saturated with silica.

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[4] s. Roy. Soc. Can., 1890, pp. 14-18.

[5] See Review by T. A. Jaggar : Jour. Geol., 1899, vol. VII, No. 3, pp. 300, etc.

MICHIPICOTON IRON RANGE.

By A. P. Coleman and A. B. Willmott

Instructions to Dr. A. P. Coleman.

> Instructions have been sent to Mr. Boyd to withhold all iron-bearing lands in the Michipicoton Mining Division from registration, pending an examination of the region by a competent expert, and a report on the apparent extent and value of the iron ores. I have to inform you that you have been selected to make such examination and report, and to request you to proceed at once to Michipicoton for that purpose. Prof. Willmott had better go with you, and you will exercise your own judgment as to other help, whether you take with you the men you have engaged for the season or depend upon getting men at Sault Ste. Marie or Michipicoton River. I think you have already examined the hematite deposits of Gros Cap, but it may be advisable to make a more careful examination of them with a view to determine their relation with the rock formations. I remember that there are some small showings of iron ore on the south side of Michipicoton bay, just south of the small creek which enters the lake at the foot of the mountain, but I am not aware that there are any deposits of value in that locality. The largest deposits are said to be north of lake Wawa, and I learn from Mr. Boyd that Mr. Ely, an American iron owner, has recently acquired nine claims which were staked out by one Alois Goetz, for which he has paid $35,000. Mr. Clergue, of the Sault Ste. Marie Pulp Works, has also acquired a number of claims staked out in the same vicinity, besides two or three of the Johnston locations immediately north of the east end of lake Wawa. Mr. Clergue believes that there are very extensive hematite deposits several miles north of the claims acquired by Ely, yet I do not know whether any discoveries have been made there by him or his explorers. There is a third deposit of ore about twenty miles west of Magpie river, along the Herrick line, the locality of which is probably known to Prof. Willmott. It must be very near the head waters of Dog river, and is probably the same place as is marked "McDougall Mine" on your new map of the Michipicoton Division. I do not know how you can most easily reach this region, but if Herrick's line can be located where it crosses Magpie river the best plan, I should think, would be to follow that line from the river westward. When you have examined the known deposits of ore—and there may be others since discovered of which I have no knowledge, but which may have been reported to Mr. Boyd—you will be guided in the making of such further exploration of the region as you may think necessary. You are requested to make a preliminary report on this exploration work as soon as it is completed, and you are also asked to suggest or recommend such scheme in dealing with the lands as you think is best suited to serve the interests of an iron mining industry in our own Province, including the smelting of the ores.
>
> July 8, 1899. A. B.

IN accordance with instructions given by Mr. Archibald Blue, Director of the Bureau of Mines, the geologists of the Bureau set out by steamer for Sault Ste. Marie on July 15. On July 18 Little Gros Cap was reached, canoes, supplies, etc., having been brought by the steamer Telegram, and the iron deposit near the harbor was examined.

Red and Brown Hematites.

Red Hematite at Little Gros Cap.

On the lakeward side of Little Gros Cap red hematite is found interbanded with thin bluish layers of cherty material. The banding runs about northwest and southeast, so far as can be ascertained, and the dip is 45° to the southwest. The ore is lean so far as it can be seen on the dump formed by the old workings; but Captain Grierson, who was employed in the mine, states that a body of good ore was found at the bottom of the shaft. Further details are given in last year's report of the Bureau. The property has been acquired by Mr. Ely for Minnesota and Illinois capitalists according to current reports. The rock associated with the ore is partly chert, partly fine-grained sandstone or quartzite, and the deposit suggests in some respects those of the Vermilion range, Minnesota; though no red jasper occurs at Gros Cap, as happens in the Minnesota iron ranges. The exact strike of the ore beds is not easy to determine. The nearest schistose rock has a strike of north 60° east.

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only other deposit in the region on ıny work has been done is at Boyer lake, nine or ten miles to the northeast and about a mile and a half from Wawa lake. Here a large of brown hematite or limonite is opened up by the Clergues. The ment consists mainly of stripping on 8 at the east end of the small lake, he ore rises as low cliffs above the nd probably runs some distance below The ore is generally dark steel gray, d on fresh surfaces, but some parts wn, or yellow, or red. It is generally ure in appearance, no pyrite being nd few impurities of any kind, though recciated fragments of sandstone or ccur on the north side of the deposit. ping shows an ore body more than 450 length from east to west and 350 from o south, rising at the highest point 94 ove the lake. A drill hole 15 feet ssed through solid ore, and the deposit bly much thicker than that, but its ickness can be determined only by mond drill or by sinking a shaft. The estimate of the ore in sight would be tons, and the actual amount is ly much greater than this.

ore body stands apart from the adjoinks and seems to be of a different probably of much later age. The dings are very peculiar. A very ill rises 460 feet above Boyer lake just east of the ore deposit, and steep alls enclose the lake to the north and The lake is 115 or more feet deep nclosed in a rock basin. No ore of ount is found on the hill top nor on ining rocky ridges; and at the west the lake sandstone heavily charged rite occurs. The ore body does not against the adjacent hills, but is ed from them by small ravines. The ke to the west (Glen lake on the map, roperly Sayers lake) has very large deposits of pyrites on its shores; and it looks as though the mass of brown hematite originated from osition of the great masses of pyrites soft sandstone, which decayed away leaving the lake basins. The hills enclosing Boyer lake like an amphitheater may have served as a kind of funnel to concentrate the solution of iron, which was then deposited in the east end of the narrow valley of lake Boyer.

If this theory is correct the ore deposit on claim 68, and reaching also into claim 69, is an exceptional thing due to the particular conditions found at Boyer lake. The ore is entirely different from that of Gros Cap or that of the Vermilion range in Minnesota, where jasper is the accompanying rock and the ore itself is red hematite. The other claims taken up in the Boyer lake region are of a quite different kind and show no large bodies of ore.

A Possible Iron-bearing Range.

Nature of the Rock Formation at Boyer Lake.

Just north of the Boyer lake deposit dark cherty sandstones with a little iron ore occur, standing nearly vertical and striking about east and west. They look like the rock accompanying the Gros Cap iron ore, and resemble even more strikingly the iron-bearing rocks of the Vermilion range in Minnesota. The flinty iron charged rocks extend for more than a mile along the ridge east of Boyer lake, and are found also toward the west for some distance, though they appear to vanish before reaching Magpie river. Whether they are connected with those of Gros Cap has not been proved.

The adjacent rocks at Boyer lake are chloritic and sericitic schists both to the north and south. Just east of Boyer lake a broad band of hard felsite, bluish and charged with pyrite when fresh, runs parallel to the iron-bearing sandstones, generally forming the crest of the lofty ridge locally known as Waterpower mountain. This felsite weathers dark brown, and is covered by a layer of brown iron ore an inch or a few inches thick. The latter has been held to indicate the presence of bodies of iron ore, and at several points trenches have been made across it. Wherever the trench goes into solid rock however it is seen that the ore forms only a crust, not a body of any dimensions.

Development work on Ely's Claims.

About 150 feet below the summit of the ridge Mr. Ely has commenced to tunnel into the cherty sandstone, expecting to open up a large body of soft ore, since he thinks the formation is closely like that of the Vermilion range and the conditions favorable. At the time of our visit the work was just begun and little can be said as to results. The rock penetrated was banded sandstone or chert, with a little ore. A vein of brown hematite a few inches thick was cut by his work and contained good ore, though in small quantities. Mr. Ely considers the outlook promising and has already expended more than $50,000, if reports are correct, in purchasing options and in development work. His experience in the Minnesota iron region makes his opinions of importance, and it is to be hoped that he will find a large body of good ore.

As no work has been done elsewhere on the range it will not be necessary to describe other parts of it in detail.

Tracing the Formation towards the East and Northeast.

Just south of lake Eleanor, and about 2½ miles northeast of the last portion of the iron range seen east of Boyer lake, rocks of the same kind occur on No. 14 of the old Johnston locations, sandstone and chert in thin layers with a little impure magnetite forming interleaved beds on the face of a steep hill. No ore of importance could be seen, however. From this a chain of small lakes was followed to the northeast, as shown on the accompanying map, and outcrops of the same rock with more ore less ore were found just east of Scott lake and Goetz lake, carrying the range four or five miles farther. East of Goetz lake, near Parks lake, Mr. Alois Goetz has staked ten claims of 40 acres each, covering probably more than a mile of the range. Here large masses of soft and hard red hematite lie scattered along the shore and in the soil, and some brown hematite also occurs. A little stripping has been done exposing red hematite in place, so that the deposit may prove of importance, since the rough fragments are scattered over a considerable surface, and some of them at least are of excellent ore.

Showings of Red and Brown Hematite.

Near Magpie River.

The next point at which the formation was seen by us is east of a lake expansion of Magpie river, about six miles north of Goetz lake, where sandstone and black chert with some red jasper occur. Seams of magnetite and red hematite are interbanded with them and thin beds of fairly good ore may be seen, but none of workable size so far as observed. This part of the range forms a series of lofty hills ending in a lake, and was followed by us for about two miles.

As no discovery of the iron range had been reported west or north of Magpie river we did not attempt to follow these rocks farther in this quarter, but returned to Wawa and made our way by a new canoe route to Hawk lake and thence to Missanabie. On lake Manitowick we found two prospectors encamped. Though reticent, they left the impression that iron had been found by them seven miles to the west, not far from Jackfish lake. As their statements were vague and we could secure no guide to the supposed iron deposits, we passed on.

The Iron Range at Dog River.

McDougall's Claims.

Our next visit to the range was at McDougall's claims near Dog river, reached by ascending White river to Pokay lake, portaging across the mountain portage, and descending Dog river for about 14 miles to the outlet of Iron lake, three miles to the west of the main river. Here the same set of banded sandstones, cherts and iron ore occurs, with some red jasper. A small quantity of good ore is to be seen, but never in beds of more than an inch or two in thickness. Here also the rocks form a long steep walled ridge, being harder than the adjoining rocks.

East of Dog river rocks of the same sort occur, but with some differences. North of Paint lake large quantities of very impure magnetite are exposed to a width of more than 100 feet. How long the deposit is cannot be determined until much more stripping has been done. The large amount of pyrites in the magnetite and the considerable proportion of rock matter in it will probably render the ore valueless. South of the hill disclosing the magnetite there is a bed of iematite and yellow ochre on the shore it lake, giving that body of water its This ore body has not been uncovered ping, but certainly extends 200 feet he shore and has a width of not less feet. A drill hole has been made eet deep through ore, but the deposit o be thin. The ore body resembles e respects that now being developed Clergues on Boyer lake, though prob- much smaller extent.

Extent of the Range.

ortion of the iron range at McDougall's runs about east and west and has been seen by us at points about six miles apart. Whether it forms a continuous curve with the range starting at Boyer lake is not certain, probable. If the range is continuous, to the northeast nearly to lake Mani- and then bends sharply to the west river. Including Gros Cap, we have eight localities on its course and have along about 10 miles of it. Between river and Paint lake however there p of about 16 miles where it has not n found. How far west of Iron lake ids is unknown. The rough character country, its covering of forest and the ount of swampy land in some parts ts exploration difficult. The band of scribed is often less than 100 yards in so that it might easily be missed by ssing in a canoe. This probably s for the late discovery of this iron

At present many prospecting parties he woods and the whole course of the ill probably be determined before long. e of the withdrawal of the iron district cation by prospectors, many claims are taked in the hope that those staking ill have first rights when the district more thrown open.

ricans from Minnesota are showing a nterest in the region. Mr. Ely, who is stated to represent the Illinois Steel Co., was first on the field, but other parties of Americans are visit- range. Near McDougall's claims on ver we met a party of Minnesota men under Mr. James. He was disappointed with what he had seen and was going out. One of his men, an experienced iron miner of Minnesota, spoke highly of the region, but thought the valuable ore bodies would only be found by a large expenditure for test pits, as had been the case on the Vermilion range.

The deposit on Pic River.

The iron deposit on Pic river seems to be of the same character as those of the range described, but is too far from them for the assumption that it belongs to the same range. Professor Willmott examined the deposit, and the following account of it is given in his own words: "About ten miles north of Heron Bay station on the C. P. R. an iron prospect discovered by Joe Morriseau has been taken up by American capitalists. This summer a little surface work has been done in the way of stripping. The west working, on the hill top, shows a very thorough breccia of sandstone and magnetite 15 feet in width. Small narrow lenses of apparently pure ore are seen in the breccia. The wall rock on the west is a slate carrying considerable pyrite, and some of this mineral is scattered through the ore itself. Fifty feet across the strike another hillock is uncovered for a width of 30 feet. Here also there is a mixture of siliceous matter and magnetite with some pyrite. Some distance down the hillside a third stripping shows the continuation of this band as a breccia of sandstone and lean ore. The resemblance to McDougall's property on Paint lake is quite striking, though in this case the yellow ore is lacking. Another stripping 100 yards west of this band shows a siliceous magnetite 10 to 15 feet wide, carrying a little pyrite. At none of the openings is there any body of merchantable ore, but the possibilities of finding larger amounts would seem to be good."

Summary of Observations.

More Exploration and Development required to prove the Range.

In general one may say that the Michipicoton iron bearing rocks resemble, often quite closely, those of the famous iron ranges of Minnesota and Michigan, the greatest producers of high grade iron ores in the world; and they have been traced more o less continuously for more than 30 miles. The only large body of ore found on the range up to the present, that of Boyer lake, is of excellent quality and contains at least 250,000 tons, probably very much more. This deposit however seems to be of rather a unique character. It is brown ore instead of red, and seems to have resulted from a special set of conditions which may not be repeated in other parts of the range.

The only other deposits that seem to us to promise well are those of Gros Cap, Goetz lake and Paint lake. The first of these was worked years ago without very good results, but is now in the hands of Mr. Ely, representing Chicago capitalists. The other two are absolutely undeveloped and one cannot say whether they will be of importance if opened up. Whether there are larger bodies of soft ore beneath the cherty and jaspery capping of many hills of the range can only be determined by the diamond drill or by mining operations. Minnesota men that such ore bodies will be found, and experience makes their opinion of w but up to the present this has not been p It must be kept in mind in any case th iron ranges of Minnesota and Michigan many miles on which no iron depos value have been found, and the sam be looked for on the Michipicoton rang

At present one can say with certaint that one ore body of considerable size good quality has been found, and that are indications suggesting that two or others probably exist. It is likely th least a few other iron deposits of valu be found in the range now known, b evidence is yet at hand to show their ence at any particular point.

Whether the Michipicoton iron rang be found to extend farther west is n known, and the same may be said as t tinuations of the deposit on Pic river.

COPPER IN PARRY SOUND DISTRICT

By Dr. A. P. Coleman

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While Dr. Coleman was employed exploring the iron range of Michipicoton in July of the present year (1899), he was notified that upon completion of the work there he would be required to examine and report on the copper-bearing lands of the Parry Sound region, to which attention was being drawn at that time by published accounts of discoveries of large and rich deposits of copper ore. The accompanying preliminary report lacks the high coloring of the practised real estate miner's hand, but it will serve a better purpose in restraining the expectations of land owners and steadying the judgment of moneyed men. A. B.

instructed by Mr. Archibald Blue, irector of the Bureau of Mines, the Sound Mining region was visited and ore important mines and prospects ied during the latter half of August, e results of the investigation are given eliminary way in the following report.

The McGown Mine.

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region first attracted attention to its l deposits in 1894, when the McGown mine about two miles east of the limits of Parry Sound was found to contain free gold. In October year the present writer was sent to ne the property, and a description of it e found in the next report of the u of Mines.[1] At that time very little had been done upon the property, prac- only some stripping and the sinking of few feet deep by the shore of a pond. isclosed about 100 feet of an irregular d vein about three feet wide containing mixed with dark schistose rock and car- some free gold and copper ores, especi- rnite and chalcocite. As the mine was d for gold, and the amount obtained n was small, the owners grew discour- nd little further work was done until a go, when the finding of large masses of e and chalcocite on the shores of Mc- lake a few hundred feet from the al opening once more attracted atten- o the mine, this time as a copper deposit. The property passed from the hands of the McGown Gold Mining Company, consisting of local men, to those of the Parry Sound Copper Mining Company, formed of capitalists from St. Paul and Minneapolis, the transfer having been arranged by Mr. Robert Forbes, who was appointed manager of the new company. Since then the work of development has been carried on with energy, and under the stimulus of purchases of mining lands by the company prospecting for copper has been carried on extensively, proving that ores of the metal occur at many points in the district.

The Parry Sound Copper Mining Company.

The writer desires to express his appreciation of the great courtesy shown by the officers of the company, Mr. Forbes, general manager, Mr. Koren, superintendent of mines, and especially by Dr. Elftman, superintendent of reduction works, during his examination of the properties owned by the company. Without their aid and permission to travel on their steamer the work could not have been done as satisfactorily.

Description of the Property and of the Workings on it.

The McGown mine is on lot 146, con. 4, of the township of Foley, close to the road leading from Parry Sound to Rosseau. The rock enclosing the ore bodies is a coarse grained gray diorite schist, penetrated by dikes of pegmatite, and there are no well defined veins containing the ores, though small stringers of quartz occur frequently. In working the property the old inclined shaft has been straightened and continued, so that it is now 100 feet long with a vertical depth of 30 feet at the bottom; and a new vertical shaft has been sunk to a depth of 65 feet on the hill between the two lakes. It is 9 by 11 feet in dimensions, has a two-cage department and is excellently timbered. The third opening is a quarry or pit about 50 by 25 feet on the surface and 21 feet deep, now partly filled with water coming from McGown lake a few feet away. There was a more or less distinct bedded vein at the old shaft, but the later opening beside the lake discloses only a few quartz seams, the rich ore which was produced from it having formed bunches and impregnations in the diorite schist. The ore pile shows much bornite, chalcocite and chalcopyrite with some iron pyrites, but very little in the way of gangue minerals except the country rock itself. Six carloads of this ore, 143 tons in all, were shipped to the Orford Copper Company in June and gave returns of 15.68 per cent. of copper, worth at current rates for the metal $7,571.13, and leaving a balance above expenses of shipping and smelting of $5,398.80. Another shipment of about 24 tons of ore made to the same firm in July appears to have contained about the same percentage of copper, with a little less than an ounce of silver and $5 in gold to the ton.

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[1] Bur. Mines An. Rep. 1891, pp. 98-100.

There are now on the stock pile, as estimated by the company, about 200 tons of selected ore which is expected to run from 25 to 30 per cent. of copper, and 3,000 tons of lower grade ore supposed to contain from 8 to 10 per cent. of copper. All of this ore apparently came from the open pit on the lake shore; and if so the amount seems to have been somewhat over-estimated, since the contents of the pit can hardly have been sufficient for that weight of rock.

The rock coming from the vertical shaft, which is intended to tap the ore bodies far enough below the bottom of the lake to avoid trouble from water, contains some bornite and other copper ores, and from the results of Dr. Elftman's assays is expected to run about 3.1 per cent. of copper; while the rock from the inclined shaft yields from 2 to 6½ per cent. of copper and from .19 to .25 oz. of gold per ton.

Extent of the Cupriferous deposit.

The belt of rock carrying more or less copper is from 250 to 400 feet wide, and its length from the old workings to the end of the open pit 800 feet. Traces of copper have been found also 200 feet farther west than the inclined shaft. What proportion of this great mass of rock will contain enough copper to pay for mining cannot be said until the mine has been further developed. The rich ore is very irregularly disseminated through the rock, not as pockets, but rather as in a fahlband, since there are no large bodies of solid ore, and the boundaries of the ore body are very hard to define. Whether other bonanzas of rich ore like that from the open pit will be found can be determined only by mining.

At the time of my visit the foundations of a ten stamp mill were just completed and most of the machinery for it was on the ground. The amount of gold hitherto found in the ore seems too small however to justify putting up a stamp mill at this stage in the development of the property.

The Wilcox Mine.

A property in Cowper Township.

Next in importance to the McGown mine is the Wilcox property, owned by the same company, and situated in Cowper township, at the head of a long bay 12 miles from Parry Sound as reached by steamer. On August 25 a shaft intended to be 9 by 11 feet was down 22 feet; a few pits had been sunk at other points along the line of strike, and some stripping had been done. The country rock is gray garnetiferous gneiss, with a dip of about 70° to the north; and the ore body is a fahlband of this rock impregnated with copper and iron pyrites, with small amounts of pyrrhotite, bornite, molybdenite and blende. The fahlband, or copper bearing belt, is 30 to 50 feet wide at the shaft and may be traced for about 1,000 feet. Beyond this, half a mile to the northeast, a pit has been sunk on a rusty belt of rock containing pyrites, and another small shaft has been sunk 1½ miles

Ores carrying Copper, Iron Pyrites and Platinum.

showing copper and iron pyrites being visited on the way. In the township of McConkey near the shores of Caribou lake, there are a number of locations containing outcrops of a rusty diabase with more or less iron and copper pyrites and pyrrhotite. One deposit on lot 15, con. 4, contains a considerable amount of the mixed sulphides, and furnished a sample which gave an assay a little over one per cent. copper, 1½ per cent. nickel and $14 worth of platinum per ton. The assay was made on selected, not average, material; and the ore would appear to be more important for its platinum than for the other metals.

The most interesting deposit in the region is on the shore of lake Messagamasheen in Hardy township; where a shaft has been sunk 30 feet by the Parry Sound Copper Mining Company. It is now partly filled with water, but the ore dump shows considerable quantities of sulphides, pyrrhotite, chalcopyrite and pyrite, and has a striking likeness to the Sudbury copper nickel ores. There are some thick seams of the ore, but much of the rock on the dump is not highly charged with sulphides. The country rock is coarse diabase, which seems to have penetrated the Laurentian, since pink gneiss shows on the rest of the lake shore.

General Conclusions.

Caution should be observed in an Undeveloped Region.

In a general way one may say of the copper deposits in the Parry Sound district that ores are very widespread, that a few properties are likely to develop into valuable copper mines, but that the large majority of the prospects do not look particularly promising. The owners of these prospects seem to have quite exaggerated ideas of the value of their properties; a not unnatural state of affairs when, if current reports are correct, relatively large prices have been paid for farms on which little ore has been found and hardly any development work done. The largest purchaser has been the Parry Sound Copper Mining Company, which is said to own or to have options on 65,000 acres of land; part of this great area being handed over however to subsidiary companies for development. It is evident that the majority of these farms scattered over the district can never have been carefully explored, and have been taken under option in a speculative way. It is much to be desired that the two main properties should be far enough developed to prove their extent and value. They seem promising now, and it may be hoped will fulfil the expectations formed of them. If this is the case many of the other properties in the district on which traces or small pockets of ore have been found will be worthy of attention.

Geology of the Country.

It is often stated that the rocks of the Parry Sound region are Laurentian, and hence not likely to contain valuable ore deposits. In reality its geology has never been worked out in detail, and it is probable, if not certain, that much of the region corresponds to the Grenville series or Upper Laurentian of Eastern Ontario and Quebec, or to the Keewatin (Huronian ?) rocks of western Ontario. As both these rock series are well known to be rich in metals there is no reason to suppose that the so-called Laurentian of Parry Sound is necessarily barren; and the opinion of many inhabitants of the district that geologists have condemned it is not borne out by the facts.

LOWER SEINE GOLD MINES.

By James A. Bow

Instructions to the Inspector.

Owing to some uncertainty as to the Golden Star mine and the fluctuations in the stock of the Company, I think it is very important in the public interest that we should have a report on it from an independent and trustworthy point of view. One or two parties connected with the old Company have been circulating disparaging reports as to the continuation and richness of the ore body, and the effect has been to largely depreciate the shares, almost all of which are now held in Canada. I have therefore to request that you will at once proceed to the locality and make a thorough inspection and report on the mine. Careful measurements should be made to show the size and depth of the vein, the length of the several levels, the amount of stoping done, the number of winzes sunk, etc. The measurements of the width of the vein should be taken at frequent intervals along the drifts, where the ore has been taken out from wall to wall, and a careful study of the vein made to show its relations to the country rock upon both sides of it, and as to the existence of a fault or other indication that the fissure is likely to be continuous in depth as well as in length.

You are required to sample the vein carefully across the whole width of it, perpendicularly and longitudinally, down the shaft as well as along each of the levels. You will number each sample and put a card on it to denote the locality of the mine from which it has been taken, and make a record of each sample to be forwarded here, so that they may be afterwards identified. When you have obtained a full set of the samples, have them boxed carefully under your own supervision, and then forward by express to J. Walter Wells, Provincial Assay Office, Belleville, who will be instructed to make analyses of them and send a report to this office. I will subsequently put Mr. Wells' report in your own hands, so that you may use it in the completion of your report on the mine.

You will carefully report on the mill and machinery generally, with a view to show the character of the equipment and its suitableness for doing work economically.

You should also look carefully over the J041 property, and endeavor to ascertain if the vein of the Golden Star extends into J041; also whether it extends southerly from the Golden Star, and what its probable length may be. If there are other mineral-bearing veins on the Golden Star notice should be taken of them also.

I have further to request that you will make one of your ordinary inspections of the Olive Gold mine, and of other mining properties in the same locality, and make your report upon these at the same time that you report on the Golden Star.

July 7, 1899. **A. B.**

I BEG to report herewith, as directed by you, the result of my examination of the Golden Star and other properties in the Lower Seine River locality.

Varieties of Gold-bearing Formations.

Varieties of gold-bearing formations in the Lower Seine.

There are four important varieties of gold-bearing formations in the Lower Seine, namely: 1. The well-known protogine or irruptive granite, containing numerous quartz fissure veins, and represented by such mines as the Foley, Ferguson, Lucky Coon, Golden Crescent, Decca and Manhattan, besides many other locations not developed. 2. A band of felsite schists filled more or less with quartz stringers from a fraction of an inch in width to two or three feet, both parallel with and crossing the strike of the schists. This formation extends about 20 miles or more from the west of the Olive to beyond the Sturgeon Falls and runs about east and west. It is represented by the Olive, Alice A Emma Abbott, Gold Bug, Independence and numerous other locations undeveloped. I think the Fighting Chance is on the same belt, but this property was not visited by me. 3. There is next a formation of hard green schists adjoining the felsite schist I believe, on both sides. This formation contains bedded quartz veins and quartzitic pyritiferous belts which would probably form both small high grade and large low grade propositions similarly to the felsite schists. The Swede Boy mine is on this formation. A band of conglomerates extends for about 15 or 20 miles east and west, south of the schists above mentioned. 4. The smallest formation, but equally important to any of the others, is that of the Golden Star, JO41, and two or three of the adjoining properties. It consists of massive porphyry and greenstone, cut by numerous dikes of greenstone, felsite, etc., of different ages. This formation is bounded by conglomerate and protogine on the south, as shown by the accompanying plan, and by green schists and trap on the northeast, north and northwest. A small body of conglomerate is found at one point on the north of JO41. The porphyry and protogine are later than the conglomerates, as proven by the study of the contacts. Inclusions of the conglomerate in which traces of the boulders are almost obliterated are found not more than 100 feet from the main shaft of the Golden Star, both north and south, and conglomerate pebbles are found in the protogine near the contact. Doubtless the porphyry is the latest formation of the three. Both the porphyry of the Golden Star and the greenstone of JO41 are intimately associated. Dikes of greenstone and felsite are found in the porphyry, and dikes of lighter colored siliceous rock are found in the greenstone. The relations of these two formations to each other is difficult to understand. To sum up, the formation changes from that of a siliceous porphyrtic and felsitic nature on the southern part of the Golden Star property to a coarser-grained greenstone on the northern part of JO41, and great disturbances must have taken place at the time of their production as evidenced by the dikes and inclusions of other rocks in each.

Golden Star Mine.

Surface indications of the Property.

The main shaft of the Golden Star is 260 feet from the eastern boundary and 680 feet from the southern boundary of location AL114. The protogine is about 1,000 feet from the shaft, and the conglomerate about 300 feet. As to whether these formations dip towards the shaft, it is difficult to say. Nothing of any vital economic importance can be determined in the matter. Going south from the main shaft the ground rises gradually to a height of perhaps 70 or 80 feet for a distance of about 300 feet, or to the conglomerate contact. The Golden Star vein has a strike of about north 35° west. North of the shaft there is no evidence of the continuation of the vein visible at the surface on the Golden Star property, owing to the fact that the rock is not well exposed, although on JO41 a vein outcrops which will be mentioned later. The first evidence now visible of the vein on the surface is in a test pit eight feet deep and 80 feet south of the shaft. The vein is six feet seven inches wide, and consists of four stringers of quartz, aggregating two feet seven inches. About 20 or 30 feet south of this the vein branches, one branch bending to the east slightly and the other to the south, the latter with a strike of north 15° west. The evidence of this consists of lines of faulting more or less distinct, with occasional outcroppings of quartz, the rock being covered more or less with soil and a sparse growth of bushes and small trees. At a distance of 60 or 70 feet south of the first mentioned test pit an exposure of the vein occurs, with two or three stringers of quartz aggregating 14 or 15 inches and a distance between the walls of over four feet, only one wall being exposed. The fault line evidently branches again south of this, the most easterly branch of which consists of a distinct line of faulting, visible a little over 200 feet from the main shaft. The central branch is shown by a five-foot test pit about 230 feet south of the shaft. There are two distinct walls five feet apart, with an inch stringer on the hanging and a six-inch stringer on the foot wall. The west branch is traceable by a line of faulting for over 350 or 400 feet south of the shaft. At a distance of about 300 feet from the shaft a test pit has been sunk 22 feet on this branch, which is from two to eight or ten inches wide on the surface at this point. A considerable quantity of felsite occurs south of the shaft, which gives rise to the theory that the vein is contained in a felsite dike, but such is not the case.

Underground workings of the Mine.

A systematic examination of the vein underground was made according to directions. The workings were measured up and plotted to scale as per accompanying sketch (the dotted outlines of stopes being approximate). The

e shaft, as near as it can be arrived
eet. There are five levels, with
e of 930 feet of drifting. The
toping done is best shown by the
he width of the stopes is extremely
nging from 18 inches to about 12
numbers on the sketch indicate
at which the vein was measured
l for assay. The positions of those
lso plotted to scale. The vein in
as sampled on the north end at
eet of depth, with a few unavoid-
ons. In the drifts and stopes the
tween the points of sampling was
er. Usually samples were taken
ssible points, at reasonable dis-
t. In many parts of the stopes
impossible, owing to the lack of
. The north end of the second
not be reached, but from previous
the vein there is known to be
g in appearance. At the north end
hand stope in the same drift there
be no vein as far as can be seen.
out near No. 125. Correspond-
face conditions, the conspicuous
th of the shaft is the branching of
hich is well defined in the first,
l third levels; and this is in ac-
ith what would be expected from
ications. At the fourth and fifth
sufficient work has been done to
e the nature of the vein in this
those depths. The dotted line
oximately the line of branching of
far down as could be determined.
feet of the first level is on the
nging wall branch, the vein dip-
e west. In the second level the
was commenced on the hanging
h and ended upon it, the central
ing widened out to include both
In the third level south the vein
hree times, but not very strongly.
t and best portion of the vein
what may be called a junction of
es, or just north of the line of
f the vein, as suggested by the
ne. As far as development work
e workable portion of the vein
a shoot from three to 12 feet in
M.

width and about 100 feet in length, extending through all the levels and pitching to the north. The walls of the vein are well defined in almost all parts of the workings. Places in which the vein is frozen to the walls are rare. The wall rock is usually decomposed next to the vein, and selvage is common. At the ends of the drifts beyond the main ore shoot the veins or branches are usually fairly definite, although selvage does not occur to the same extent. In some cases only one wall is reached. Near the surface the ore shoot is mainly south of the shaft and crosses to the north as shown, and gives evidence of continuity on that side of the shaft. At the ends of the first three levels south the branches of the vein, although well defined, are comparatively small. Mr. Flaherty, the manager, intends to drift further on the west branch of the vein at the second level towards the 22-foot test pit south of the shaft, where there is promise of a payable body of ore, and crosscutting will be done in both directions. The fourth level south is rather discouraging in appearance, but the fifth level shows a fairly strong vein south of the shaft. In the north drifts of the upper levels especially the country rock changes from the usual felsite or porphyry to greenstone; the contact cannot however be easily located. But this may be only a dike which would be passed through on further drifting. The vein is strong at the ends of the drifts, and it is possible that further drifting may reveal workable ore. In the shaft the vein varies considerably in width. A few feet of broken rock prevented access to the bottom of the shaft, but as far as can be seen the vein in the lower portion of the mine is wider than usual, the foot wall not being reached at all in parts of the workings, but the quartz is lean looking and the walls have little or no selvage. The character of the ore varies considerably in different parts of the mine. I understand that a very rich body was found between the second and third levels north. Mr. Flaherty struck the continuation of this, though much narrower, while stoping in the fourth level, and he informed me as I was leaving that there were evidences of its coming in at the fifth level north also, where stoping and drifting were in progress. In the fourth level stope the rich streak is only from six to eight inches wide and extends along on the hanging wall side of the vein. It is heavily charged with galena.

Suspension of Development Work by the former Owners

Before the stamp mill was installed and in operation, which was on 9th November, 1898, the shaft was considerably over 300 feet deep and four levels had been established with an aggregate of over 700 feet of drifting, besides upraises and winzes. This meant, of course, besides the large amount of ore blocked out, an extensive ore dump on the surface. Since the mill has been in operation development work has been practically suspended, with the exception of the establishment of the fifth level and a little drifting at the third and fourth levels. For the past six months practically no development work has been done, until lately under the new management. Thus, with a large amount of ore blocked out and a dump on the surface representing the product of development work, completely equipped hoisting, transportation and milling plants, the owners were enabled by a knowledge of the distribution of the different grades of ore under ground to stope out accordingly and govern the output of the mine from month to month as they desired. By suspending development work, and otherwise keeping down temporary expenses, the profits were additionally enhanced for the time being. But although the blocked out portion of the mine has been mostly gutted, there is no reason why development work should not even now be kept sufficiently advanced to keep the mill running steadily. The ore shoot has every appearance of continuity and depth, and the vein shows no positive indication of discontinuance in length. The present management must pursue a conservative policy for a few months until development work has been sufficiently advanced to insure a future reserve compatible with the capacity of the mill.

The mine was left by the old management in a poor condition. The timbering of the stopes was unsafe, the loading stations [illegible] the shaft [illegible] the ladderway [illegible] ed considerable improvement, an[illegible] way was insecure, besides other [illegible] less importance. Unde[illegible] management these defe[illegible] ing remedied as fast as convenient. [illegible] tilation is not very satisfactory [illegible] An air shaft to connect with the n[illegible] the first level was advised. Ther[illegible] siderable quantity of water comin[illegible] shaft, but this is easily controlled [illegible] at the third level and one at the [illegible] the shaft. Machine drills operat[illegible] pressed air are employed; five [illegible] altogether for stoping and develop[illegible] The hoisting plant includes a ski[illegible] structed as far as the fifth level, [illegible] lb. skip, automatically dumping [illegible] face: a ¾-inch steel wire hoistin[illegible] duplex hoist with 8½ by 12-inch [illegible] band brake and friction clutch: a[illegible] inches in diameter. Owing to the [illegible] ties in the shaft the skiproad is [illegible] exercise of considerable care bein[illegible] to prevent the skip from leaving [illegible] This can be avoided by providi[illegible] back timbers, such as has been [illegible] the surface to the first level. I[illegible] were left to provide such timbers [illegible] length of the skiproad. A smal[illegible] hoist has been provided at the fift[illegible] sinking in the shaft, which work [illegible] delayed pending the arrival of t[illegible] machinery. A satisfactorily tim[illegible] tion has been constructed under th[illegible] Tramways are laid in all working l[illegible] ore stoped out is broken down up[illegible] stulls with mill holes in these to [illegible] ore to the cars in the levels. Bot[illegible] and underhand methods of stopi[illegible] ployed.

Condition of the Mine.

Tramway [illegible]

The ore is conveyed to the mill [illegible] Aerial Tramway 2700 feet in le[illegible] [illegible] lower portion of the [illegible] ascends ups and do[illegible] [illegible] way, which is su[illegible] steel standards at varying dista[illegible] The discharge terminal is 10 feet [illegible] the loading terminal. Three [illegible] power is sufficient to operate the [illegible] The buckets [illegible] having a [illegible] 800 lb. [illegible] and a speed of [illegible] per second. The buckets dump directly into the crusher at the mill. The tramway, and of course the crusher also, only runs 10 hours out of the 24. One man is required at each end to load and unload the buckets, etc. Fifty feet of tramway extends from the shafthouse to a pocket at the loading terminal. This pocket (lately constructed) has six separate lips for the discharge of the ore into the buckets. The different grades of ore can be thus kept separate, and mixed as required in order to maintain a uniform output of bullion.

The Mill on Vermilion Lake.

The stamp mill, which is on J041, has a very good site on the Bad Vermilion lake. The foundation is solid rock. The buckets discharge at a sufficient elevation to admit of all handling of ore and tailings by gravity. The building is commodious, and substantially and neatly constructed. The machinery consists of the following :

1 Comet D Crusher with a 100-ton ore bin underneath.
2 Batteries of 5 stamps each.
2 Challenge Ore Feeders.
2 Brown's Two-Compartment Hydrometric Sizers.
4 Frue Vanners with 6-foot plain belts.
12″ by 30″ Corliss Engine and two 80 h.p. Boilers, besides the Air Compressor.

The mill and other buildings in connection with the mine are lighted by a 60-lamp dynamo. Mr. Flaherty estimates the capacity of the mill at 30 tons per day, but it is possible that this figure would be found too low if an exact method of estimation were employed. Mr. Kerr, the former superintendent, told me that about 35 tons on an average were being treated daily, and as much as 41 tons had been put through in 24 hours. The ore of course varies in hardness, richness, and in free-milling character. Rich ore with a considerable amount of concentrates requires longer treatment, and hence reduces the capacity. The following details of mill practice are now adopted : Weight of stamps 1020 lb. ; number of drops, 96 per minute ; height of drop, seven inches on an average ; materials of shoes and dies, forged steel ; depth of discharge, variable, usually from 2½ to three inches, although the range extends from 1½ to eight inches according to the nature of the ore. Rich ore with a large percentage of concentrates requires a deep discharge, thus allowing of finer comminution and longer treatment. Screens, 40-mesh diagonal slot, with area of 4′ 2″ by 9¼″, single discharge. No inside amalgam plates are used. Apron plates, 12′ long by 4′ 7″ wide with 1½ drop in centre ; inclination, 1¾″ per foot. There is only a small percentage of concentrates in the ore, as is usually the case with the mines of Western Ontario, but their value is high. They are not treated at the mine. The hoisting, transportation and milling machinery is in a satisfactory working condition and has been installed with a view to reasonable economy to the handling of the ore. About seven or eight cords of wood per day are used at the mine and mill, and it costs delivered $2 37½ per cord.

Buildings and Employes.

The following buildings are on the property : Shaft house, engine house, blacksmith's shop, dry, store house, mill building, tramway terminals, office, powder magazine, boarding camps, stables several private dwellings, and others. The following force is employed : In connection with mining—four drill men, four trammers, three timber men, two landers, two engineers, a blacksmith, and several temporary laborers. The mine captain is Mr. E. J. O'Brien. In connection with milling—superintendent, George M. Kugler, a carpenter, a night amalgamator, two engineers, two firemen, wood passer and helper in mill. In connection with transportation of ore—one man at each terminal.

Costs and Wages.

Mr. Flaherty furnished me with the following summary of costs per ton : Mining $2.78, milling $1.34, and transportation 17 cents, making a total of $4.29 per ton. Wages are higher here than in other parts of the district. Machine men are paid $2.75 a day ($3 at some of the mines in the vicinity,) and other workmen in proportion. Board is obtained for $20 to $22 per month.

Transportation.

A small steamer is employed by the Company for the transportation of supplies, &c., on Bad Vermilion lake. The Government road from Mine Centre, which is at a distance of 4½ miles, has been in poor condition for the greater part of the season, but improvements are now in progress.

In the selection of the samples from which the assays were made a piece from half to three-quarters of a pound was taken at intervals varying from a fraction of an inch to eight or ten inches, according to the width of the vein and the character of same. Where the vein was narrow, from a couple of inches to eight or ten inches in width every inch across was sampled. Where the width was about five feet or more, pieces were taken at equal intervals of six, eight or ten inches, according to circumstances. For other widths of the vein intermediate pieces were taken at correspondingly smaller intervals. At each place sampled the pieces were of uniform size, or a uniform amount was taken at the different points acro as nearly as could be judged, ar distances apart, although, as state the vein were narrow or the qua in character the pieces were take intervals or more frequent than were wide or uniform in chara siderable care was exercised to h oughly uniform sample in each c the assay value would represen age value across the vein at t The samples were taken by h moil, with the assistance of and they were put up and se my direct supervision for shipm press to the assaying office at The results obtained are given in ing table.

Sampling of the Mine.

Assays of the Samples.

No.	Width of vein.		Width of quartz.		Assay Value.	Remarks.
	Feet.	In.	Feet.	In.	$ c.	Total width of vein sampled unless otherwise st
1	3	7	1	6	1 65	
2	3	10	3	0	1 85	The vein at all points sampled possesses definit and hanging walls except where otherwise rem
3	4	9	4	9	—	
4	6	1	5	11	trace	
5	6	3	4	7	"	
6	6	4	3	10	1 22	
7	5	8	5	8	trace	
8	6	0	6	0	—	
9	7	4	7	4	1 65	
10	6	7	6	7	1 20	
11	6	3	6	3	trace	
12	6	0	5	8	—	
13	5	4	4	10	trace	Foot wall not reached between fourth and fifth except near the fourth.
14	5	3	4	6	—	
15	4	3	4	3	1 44	
16	4	0	4	0	5 98	
17	4	0	4	0	33 04	
18	3	0	3	0	6 60	
19	1	1	1	1	1 22	
20		11		11	82	
21	2	6	2	6	trace	
22	3	0	3	0	1 02	
23	2	0	2	0	23 57	
24	1	5	1	5	5 57	
25		2½		2½	—	Vein pinched out entirely between 24 and 25, le only a seam.
26		6		3	trace	
27	2	9	2	7	3 51	
28	4	10	1	6	2 88	
29	4	3	1	2	1 02	
30	9	10	1	8	trace	Quartz in two branches 7" on hanging and 13" on Quartz only sampled.
31		7		7	7 43	Hanging wall branch exposed. Foot wall, branch exposed at level where sample 30 was taken.
32	4	4	3	10	8 46	
33	2	10	....		84	Stringers of quartz mixed with felsite.
34	1	8	1	3	1 02	
35	1	0		10	1 44	Vein pinched out between 35 and 36, leaving a di seam.
36		8		6	3 91	
37	1	2		9	3 09	
38	1	5	1	0	35 47	
39	1	4	1	0	3 91	
40	1	9	1	9	5 78	
41	1	0	1	0	5 57	
42	1	6	1	6	2 47	
43	3	10	2	6	15 28	

Assays of the Samples

No.	Width of vein.		Width of quartz.		Assay Value.		Remarks.
	Feet.	In.	Feet.	In.	$	c.	Total width of vein sampled unless otherwise stated.
44	4	10	4	0	8	05	Foot wall not reached
45	2	10	2	10	50	63	
46	2	0	2	0	56	58	
47	1	3	1	0	5	36	
48	2	0	1	7	10	11	
49	1	3	1	3	34	89	
50	2	0	2	0	4	74	
51	2	3	2	3	9	70	
52	2	6	2	6	4	54	
53	2	10	1	6	3	52	
54	3	0	3	0	4	33	
55	3	5	2	7	117	06	
56	3	8	2	3	1	44	
57	2	2	2	2	11	97	
58	1	8	1	8	74	92	
59		10		10	2	08	
60	1	0		11	trace		
61	1	5	1	0	1	02	
62	1	8	1	8	1	44	
63	2	6	2	6	2	47	
64	1	9	1	9	3	09	
65	1	10	1	8	3	29	
66	1	6	1	6	10	73	
67	1	6	1	6	1	44	
68	1	7	1	3		84	
69	2	7	1	4	9	08	
70	2	3	1	6	43	15	
71	2	0	2	0	101	59	
72	2	10		11	45	63	
73	2	3	2	0	17	55	
74	1	10	1	10	17	10	
75	....		....		1	22	Sample of foot wall material adjacent to vein. Thickness of wall rock sampled, 2' 1", where slope has been suddenly widened.
76	....		....		2	27	Sample taken from about a dozen points on foot wall, covering a distance of 50 or 60', where portion of vein is left in wall.
77	1	1	1	1	17	34	
78	....		....		--		Sample of country rock across drift adjacent to vein on foot wall side. Width sampled, 1' 10".
79	7	8	3	0	7	43	Vein here really consists of two branches, one on each wall. Hanging wall branch, 1' 7". Foot wall, 1 5". (Quartz only sampled.)
80	....		....		trace		Sample of country rock between branches of vein at 79. Width sampled, 4' 8".
81	7	0	3	3½	13	21	Vein in two branches similar to 79.
82	6	2	4	0	37	58	Whole vein sampled.
83	6	5	6	5	8	67	Country rock pinched out. Calcite mixed with the quartz in the centre of the vein.
84	3	6	3	6	4	54	
85	3	11	3	5	9	91	Quartz in foot wall of stope.
86	3	3	3	3	113	06	Quartz mixed with foot wall rock.
87	3	7	3	1	22	50	A little quartz in foot wall.
88	3	10	1	11	2	67	Walls rather indefinite compared to other places on vein.
89	1	1	1	1	2	89	The vein in the 2nd level south is in two branches. Hanging wall branch drifted on near shaft.
90	1	1	1	1	3	50	
91	6	3	3	8	2	27	Both branches of vein exposed at this point. Country rock between not sampled.
92	5	3	5	0	3	50	Country rock pinched out.
93	4	4	4	4	14	26	
94	4	4	4	0	trace		
95	6	2	3	4		82	Branching of vein in evidence here. Sample taken all across.
96	6	2	1	9½	--		Branch on each wall. Hanging, 13½" quartz; foot wall, 8".
97	......		....		--		Sample of country rock between quartz stringers or branches of vein at 96. Widfh, 4' 4".
98	11	6	1	2½	1	22	Only quartz sampled.
99	....		....		trace		Sample of country rock between stringers at 98. Width, 10' 3½'
100		7		7	2	06	Hanging wall stringer or branch.
101		3		3	1	44	" " " "
102		2		2		82	Widens to 12" between 101 and 102. Hanging wall branch.
103		7		7	2	68	" " " " " " "
104	9	10	5	0	2	26	Consisting of quartz and country rock mixed.
105	8	0	4	0	1	65	" " " " "
106	7	10	7	10	3	10	
107	9	6	....		1	86	A little country rock mixed with the quartz in centre.

Assays of the Samples

No.	Width of vein.		Width of quartz.		Assay Value.		Remarks.
	Feet.	In.	Feet.	In.	$	c.	Total width of vein sampled unless otherwise stated.
108	11	10	2	4½	2	47	Only 1½" of quartz in hanging wall branch. Only foot wall branch sampled.
109		3		3		82	Foot wall branch.
110		8		8	—		
111		2		2	1	62	Hanging wall branch. (Vein branched a second time.)
112	3	6	3	6	1	84	Foot wall branch.
113	7	6	2	6	5	90	Only foot wall branch sampled. A little quartz is mixed with the country rock right across drift. Hanging wall branch very small.
114	6	6	2	1			Vein branched again near end of drift. Only the quartz sampled.
115	7	0	....			84	Sample taken across roof of drift consists of quartz and country rock mixed, mostly country rock. Branches of vein on each side small.
116	6	0	1	3		84	Sampled all across. Quartz mixed with the foot wall rock.
117	....		....		1	22	Sample of vein matter consisting of quartz and country rock mixed. About 2' in thickness on foot wall.
118	....		....			84	Sample taken along crosscut. All country rock. Sampling commenced 18" from vein. Taken across a distance of 7' 8".
119	....		....		1	22	Sample of about 12" of vein matter, (quartz and country rock mixed) in foot wall.
120	....		....		trace		Sample of vein matter left in foot wall. Sample taken from several points along wall of drift.
121	....		....		1	02	“ “
122	2	11	....		30	79	Mostly quartz. Sample of vein. Both walls exposed.
123	3	0	1	8	21	91	Quartz in several stringers.
124	2	1½	2	1½	19	01	
125		9		9	3	30	
126	3	9	3	9	1	02	
127	2	4	....		15	70	127 is a continuation of 126, there being 2' 4" of quartz and felsite mixed, adjacent to the vein on foot wall.
128	3	10	....		2	47	Quartz and felsite mixed, mostly quartz. Foot wall indefinite.
129	3	4		6	—		Stringers of quartz in felsite. Walls are not very definite.
130	2	10½	2	10½	32	45	
131	2	8	2	6	84	12	
132	2	1	2	1	56	42	
133	1	1	1	1	20	23	
134	1	0	1	0	7	01	
135	2	0	2	0	67	79	
136	1	10	1	10	10	06	Quartz in foot wall mixed with country rock.
137	1	10½	1	10½	41	14	Stringers of quartz in foot wall.
138	3	7	3	7	17	77	
139	4	0	4	0	13	43	
140	3	0	3	0	25	21	
41	2	4	2	4	19	02	
142	2	1	2	1	31	21	
143	1	8½	1	6	33	89	
144	1	8	1	8	17	97	
145	3	2	3	2		84	
146	3	8	3	0	4	96	
147	4	3	4	3	3	72	
148	4	7	4	7	2	06	
149	5	0	4	0	1	62	Quartz in foot wall.
150	1	11	1	11	1	82	
151	1	5	.	.	3	64	Mostly quartz. Slightly mixed with country rock.
152	2	5	1	11	trace		
153	2	0	2	0	50	52	
154		11	. . .	..	2	47	Mostly quartz. Mixed.
155	1	2	1	2	5	37	
156	2	0	2	0	4	12	
157	6	7	.	...	1	62	On hanging side of vein is a well defined quartz body 2' wide, with definite walls. Remainder of vein is mostly quartz mixed with country rock. Regular foot wall not reached.
158	3	4	2	5	1	82	Definite vein 2' 5' on hanging side. Sample taken across roof of drift. Regular foot wall evidently not reached.
159		. ..	2	1		62	Definite vein on hanging side. Sampled across roof of drift. Width 4' 5". Rock on foot wall side consisting of quartz and country rock mixed, mostly country rock.
160	3	8				82	Mostly quartz; 8" or 10" of felsite on foot wall side. Vein narrower at bottom.
161	4	4	4	4		62	Foot wall not reached.
162	5	8	5	8		82	
163	6	4	6	4	—		

Assays of the Samples

No.	Width of vein.		Width of quartz.		Assay Value.	Remarks.
	Feet.	In.	Feet.	In.	$ c.	Total width of vein sampled unless otherwise stated.
164	6	8	6	0	trace	No selvage on hanging wall. A little on foot wall.
165	5	10	5	10	--	Hanging wall indefinite. Foot wall definite with selvage.
166	....		....		2 26	Sample taken across a horse of country rock; width 2½'; a little quartz mixed with the rock. A little stringer of quartz had been followed by the drift, under the belief that it was the hanging wall; but the drifting and stoping is now carried on east of this, where a wide body of quartz (the regular vein) was crosscut.
167	3	5	3	5	trace	Samples taken only where possible, the timbers having been removed. Shaft timbered to first level.
168	....		....		82	Sample taken across 2' 6" of the vein starting at foot wall side. Hanging could not be reached.
169	...		....		2 06	" "
170	4	2	4	2	3 30	
171		2		2	2 26	Sample taken at mouth of 22' test shaft over 300' south of main shaft.
172	6	7	2	7	1 02	Sample from 1st test pit 80' south of shaft. Quartz in four distinct stringers. Definite walls. Test pit 8' deep. Point where sample taken shown on plan.
173		8½		8½	82	Samples from 22' feet test. Shaft over 300' south of main shaft. Depth of sample, 21' 10", north end of shaft.
174		8½		8½	--	Same depth at opposite end of shaft.
175		11		11	62	Depth, 16' 3". Foot wall indefinite: hanging definite, showing selvage.
176	1	8	1	8	1 24	Good hanging wall; indefinite foot wall; depth, 13' 2".
177	1	0	1	0	1 02	Depth, 7' 5".

The average value of the 177 samples is $10.31, which must be regarded as quite satisfactory in view of the fact that the samples were taken fairly from all parts of the workings, regardless of the quality of the ore. With selected ores such as would be possible for milling when development work is adequately maintained, it is obvious that a considerably higher average might be looked for; but with ample supplies of ore blocked out, and the milling capacity doubled (as is planned by the new management), an average of $10.31 per ton would assure the payment of liberal dividends.

Locations adjoining Golden Star.

JO41 is a location of 105 acres adjoining the Golden Star property on the northwest.

JO41.

The Golden Star vein has been generally spoken of as extending on to JO41 property. The greater part of this property is covered by swamp and bush, and the vein could not be traced northward without great expense in stripping. But there is a vein outcropping at a distance of 1,300 feet northwest of the Golden Star shaft, where the first exposure of rock occurs on JO41. It may be the continuation of the Golden Star vein, but I doubt it, as the variation of strike would necessarily be considerable. This outcropping is three or four feet wide, and is exposed at both ends of a test pit sunk a few feet upon it. The walls are fairly well defined, but the vein is only traceable for a short distance at this point. About 800 feet farther north, on about the same line of strike and separated by a muskeg, the ground rises rather abruptly, exposing a vein one to 2½ feet in width and traceable for over 100 feet. This probably is the continuation of the preceding vein. Near the southwest corner of JO41 and 50 or 60 feet from the eastern boundary an outcropping of quartz 10 feet wide occurs. This is the continuation of the vein which is traceable for over 500 feet with a strike of about north 60° west on the adjoining location. Over half the vein is stripped. It averages 2½ or three feet in width and has well defined walls. The country rock is massive greenstone. The vein certainly looks promising.

On the western side of AL114 a quartz vein outcrops which is traceable for over 200 feet with a strike of about north 40° west. It ranges from a few inches to two feet in width. Near the southeast corner of AL116 an outcropping four feet

AL114 and 116.

wide occurs which is a continuation of the Randolph vein on AL115.

Randolph Farm.

What is know as the "Randolph Farm" or mining location AL113, adjoining the Golden Star on the west, has recently changed hands, and operations have been commenced by the present owners. There were on August 12 only three miners at work test pitting, but a double crew was to have been put on in a few days and camps erected. Mr. Neil Berger is foreman of the work. The formation is similar to that of JO41. There is a strong quartz vein of a promising appearance traceable for five or six hundred feet, from two to 10 feet in width, with well-defined walls and a strike of north 15° to 20° west. The quartz contains copper and iron pyrites, galena and zincblende. Two test pits have been sunk about 300 feet apart on the vein; one 3½ by 10 feet in cross-section by 10 feet in depth, showing the walls well separated from the vein matter; the other six to eight feet in cross-section by eight feet in depth, apparently on a junction of this vein with another.

Randolph Mine.

Work is also in progress on AL115, a 40-acre location adjoining the Golden Star on the east, known as the Randolph mine, and owned by the Randolph Gold Mining Company of Ontario, Limited. The formation is a continuation of that of JO41 and the Golden Star, with conglomerate on the south half of the location. The vein is traceable for about 500 feet on the surface and varies in width from a few inches to three or four feet. A six by eight foot shaft is being sunk which on July 20 was 54 feet in depth. A small steam hoist is employed. A shaft house, blacksmith shop and boarding camps have been erected. There are six miners working in day and night shifts and four other workmen, under the superintendence of Mr. Neil Berger.

Olive Mine.

An extensive Band of Gold-bearing Rock.

The Olive ore body consists of a small, rich quartz vein in a large body of felsite schist. A two-stamp mill was installed two years ago which successfully treated the quartz from the small vein, and also a certain amount of the felsite schist adjoining the vein. A ten-stamp mill was erected last year with the object of treating a larger quantity of the schist, the quartz vein being too small for a mill of that capacity. As a result of continued testing the opinion grew that the whole body of felsite schist, several hundred feet in width, contained sufficient values for treatment by a large mill. This summer diamond drill testing was done with a view of determining the values contained in the schist and the width of the body. Two horizontal holes were bored at the bottom of the main shaft, a depth of 245 feet. The first hole north for a distance of 150 feet revealed 132 feet of an ore body and 18 feet of diorite beyond. The second hole was bored south from the end of the crosscut, revealing 218 feet of ore and 20 feet of diorite. This makes altogether, including the crosscut, a width of about 425 feet of ore, with an indefinite length and doubtless great depth. Whether the ore is sufficiently high grade for treatment even with a large mill is a matter that has yet to be settled. However, the foundation is being prepared for an additional 15-stamps to be installed this fall alongside the present mill. This will of course necessitate the treatment of a still greater proportion of the schist, or "dike" as it is erroneously called. It is not likely that a further increase in the milling capacity will be made after this until the new railway (which passes within a very short distance of the mine) is in operation.

Sinking and drifting.

The main shaft is 251 feet deep, with sinking suspended for the present. There are three levels, with a total amount of drifting of 615 feet, and 72½ feet of crosscutting. Considerable stoping has been done in the first level east and west, and a little at the third level west. A good body of high grade ore was passed through in the third level west. Shaft B, which is 345 feet east of the main shaft, is 70 feet deep, with 262 feet of drifting at the bottom. An additional 90 feet of drifting west will make connection with the east drift at the first level of the main shaft, thus affording good ventilation as well as giving a large amount of stoping ground.

Drilling is all done by compressed air. Five machines are in use. No stoping is in progress at present. The 10-stamp mill is kept supplied by the product of development work, five drifts being under way altogether. Mr. N. B. Hall is manager of the mine. There is a total force of 52, including 22 miners.

Location G69.

On G69 (a part of the Olive property) a shaft is being sunk on a band of green schist impregnated with quartz and heavily charged with pyrites. The shaft was 29½ feet deep at the time of my visit, with crosscutting commenced north and south at the bottom.

Swede Boy Mine.

The Swede Boy mine was visited on August 9th. This property is situated about four miles east of the Olive, and consists of location E237, owned by the Headlight Gold Mining Co. of Ontario, Limited. John McLeod is manager, with a total force of 13, including eight miners. The formation consists of dark green schist, impregnated with small seams of quartz and charged with pyrites. There are two quartz veins about 100 feet apart and parallel to the strike of the schists, which is nearly east and west. These are exposed at several points with a width of from three or four to eight or ten feet. A shaft has been sunk 81 feet on the north vein. At a depth of 75 feet a crosscut has been driven south towards the other vein 40 feet, and one north 16½ feet. It is possible that the rock between the veins may be ore. A small steam hoist is employed, and office, boarding camps and engine house have been erected.

Lucky Coon Mine.

The Lucky Coon mine, recently bought by the Lucky Coon Gold Mining Co., has been in operation by that company since early in the spring, after several years of suspension of work. There are five shafts on the property, on different veins. Two of these have been worked all summer. One, No. 5, has been recently temporarily closed down owing to inadequate ventilation. It is said to be 78 feet deep, but is half full of water. The other working shaft, No 2, is 108 feet deep. Drifting will be commenced at the 100-foot level as soon as a few feet more has been sunk. The shaft is on a good strong vein with a nearly vertical dip. Parallel veins also occur on both sides which can be economically reached by crosscutting from the same shaft. Steam hoists will be installed immediately, one at each shaft, and work on No. 5 resumed. There are at present three miners and three surface men employed under the managership of Mr. A. W. Robertson.

Ferguson Mine.

The Ferguson mine is owned by the Seine River (Ont.) Gold Mining Co., Limited, with head office at 1 Castlecourt, London, Eng. While I was in the vicinity the shafts were all pumped out and examined by a Cornish mining engineer named John Angove. If the report is satisfactory work will doubtless be resumed.

Golden Crescent Mine.

The Golden Crescent mine, formerly known as the AD2, has been bought by the Golden Crescent Mining and Exploration Co. of Ontario, Limited, with head office at Duluth, Minn. Work has been resumed this spring after a period of suspension. The shaft on the Gem vein has been sunk to a depth of 88½ feet, and a little work done at one or two other places on the property. A steam hoisting plant has been installed. Mr. W. G. La Rue is manager of the mine. There is a total force of eleven, including six miners, working by day and night shifts.

Decca Mine.

There are two shafts on the Decca, about 1,200 feet apart on the same vein. No. 1 is 115 feet deep and will be continued to 150 feet before drifting is commenced. Steam hoisting and air compressing plants have been installed. No. 2 shaft is 110 feet deep. Operations in it are temporarily suspended. Mr. F. C. Fisk is manager of the mine.

Manhattan Mine.

The Manhattan consists of location K231, adjoining the Decca, and owned by the Manhattan Gold Mining Co. of Canada, Limited; head office at Montreal. The vein is one of the widest known in the protogine. A shaft has been sunk 100 feet and 40 feet of crosscutting done at the bottom, exposing 16 feet of quartz. Steam hoisting and drilling plants have been installed. The property was examined by John E. Hardman, M.E., of Montreal, during my visit, and work which has been suspending, pending the results of Mr. Hardman's investigation, will be resumed immediately. Mr. Frank Peterson is manager.

Alice A. Mine.

The Alice A. mine is reported to have been sold to an English company under an agreement to install a large mill of 100 or more stamps. At present sinking in a test shaft is in progress. A depth of 95 feet has been reached. At 100 feet crosscutting will be done in both directions, and sinking continued at the same time. A steam hoist and small compressor have been installed. A two-stamp Tremaine mill, still on the property, made some mill runs from test pits at various points, with apparently satisfactory results. Mr. T. D. Prideaux is manager, with a force of 14 or 16.

Gold Bug and Emma Abbott Locations.

The Gold Bug, P660, and Emma Abbott, K215, were both visited and examined. They adjoin the Alice A. on the west and east respectively, and contain the extension of the same body of ore. Small test pits have been made on veins on each property. Both properties are promising looking, especially the Gold Bug, which is full of small quartz stringers and should carry gold uniformly.

Foley Mine.

The Foley mine remains in the same condition as at the former report; it is continually stated that work will be resumed immediately.

Independence Mine.

The Independence mine, near Sturgeon Falls, has been closed down for some time but it is expected that it will be opened again very soon.

On the whole, mining in the Lower Sein is in a very healthy condition. The peopl of Duluth and of the eastern cities are takin more interest in the district than eve When the railway is completed there w doubtless be a great boom in that section.

NOTES ON WORKING MINES

By J. Watson Bain

Visits to Mines in connection with Mining Classes work.

DURING the summer of 1898 the writer was instructed by the Council of the School of Practical Science to carry on Summer Mining Schools at several points in Western Ontario, under an arrangement with the Bureau of Mines, and in addition to the regular work it was decided that a series of visits should be paid to the working mines in order that, wherever possible, addresses of an instructive nature should be delivered to the miners. In the performance of this work an opportunity of inspecting many of the mines was afforded, and the following notes are the results of these visits.

Mr. James A. Bow, the Inspector of Mines, whom I accompanied on his first visit of inspection for 1898, describes minutely the condition of each mine and its adjuncts, and the observations which follow are intended to be complementary to these descriptions by dealing with the more general aspect of the work.

Silver Mountain Mines.

The West End Mine.

While at Port Arthur in May a visit was paid to two of the old silver mines, the East and West End Silver Mountain, which after a long period of idleness were being operated once more. At the West End 21 men were at work under Captain Tonkin and very encouraging results were being obtained. There are four shafts in all, but only in one, which had been pumped out to the 100-foot level, was there any active work in progress. The vein, which strikes 105° and dips at about 80°, is somewhat variable in width. At the working shaft, No. 2, a cross-section of five feet can be seen, while in a tunnel driven to crosscut the vein 850 feet to the east only three small lodes, 10″, 18″ and 22″, are to be seen. It is quite probable that the vein has split up into these several branches at some intermediate point, although this cannot be seen from the present workings. Two small stringers, with a gangue chiefly of barite, meet the main vein on the north side at a small angle; rich deposits of silver were found at the junction in each case. The vein filling consists of well crystallized calcite with green fluorite, yellowish barite and a little amethystine quartz, together with native silver, argentite, zincblende, galena and a little pyrite. The manner in which the argentite or sulphide of silver occurs is quite interesting. In several places along the north or hanging wall it had been deposited in the partings of the slates, and after knocking down a few loose fragments leaves of the mineral quite as thin as paper could be stripped from the flat surfaces of cleavage. The rich ore is carefully put aside in the mine and the contents of each bucket are subjected to a careful hand picking at the surface, while the poor ore is dumped on the stock pile to await treatment in the stamp mill.

The East End Mine.

At the East End mine the old workings are quite extensive, including a shaft 800 feet deep and a tunnel 1,800 feet long, but as work had just been commenced and there was still a great deal of water in the mine there was not much to be seen. The vein, which is continuous with the one at the West End, is much the same in appearance and general characteristics.

No other properties in the district were in operation, so that we may pass on to Wabigoon where the next stop was made.

Western Gold Mines.

At Wabigoon.

About a mile north of the town is the Northern Queen mine, with its curious ore, so heavily charged with sulphides of iron, as described in the Seventh Report of the Bureau. The shaft, said to be 50 feet deep, was full of water, so that it was impossible to determine whether the common report that sulphides were diminishing in quantity as the depth increased was true or not. However that may be the deposit is almost unique in western Ontario, and resembles somewhat closely the auriferous pyrites and pyrohotites of Rossland.

Circumstances prevented me from visiting any properties in the Manitou district, and all save one in the New Klondike region, one of the most recently discovered gold fields. This property, which is known as Tabor and Stevenson's claim, is situated near the falls of Long Lake river, SV258, and is interesting because of the occurrence of the ore as a series of lenses along the edge of a dike of felsite cutting chlorite schists. The quartz is white or slightly yellowish in color, and gives a very handsome ' tail" of gold in the pan, but from the surface indications and from what could be seen in the six feet of shaft which was not under water only a small amount of good ore could be obtained.

On Lake of the Woods Waters.

Turning next to Lake of the Woods, work was progressing steadily at the Mikado with a staff of about 60 men. The main shaft, which is vertical, has struck the lode at a depth of 185 feet, and crosscuts are driven every 60 feet to connect with the levels. A considerable body of felsite, said to run $40 to the ton, is found on the second level, and this was being opened np at the time of our visit. The mill is not equipped with any concentrating machinery, and the installation of a cyanide plant, which is being carried on at present, will add greatly to the efficiency of the plant.

At the Cornucopia and Ontario Limited everything was at a standstill, with shafts full of water, so that we pushed on to the Yum-Yum. Here one is struck with the large amount of prospecting work which has been done, and some of the veins, after stripping, look quite promising ; no work was in progress however.

Four miles to the west of Yum-Yum lies Cameron island, only some 200 yards across. On the north side, at the water's edge, can be seen exposed a dike of felsite which shows an interesting structure. A band of black felsite 18 or 20 inches in width is bedded between walls of the same rock, but red, or whitish green in color. The black material shows signs of slickensiding, and the whole occurrence would seem to indicate two separate generations of dike matter. The strike is almost north and south, and close to the centre of the island. The main shaft, 6 by 12 feet, increasing to 7 by 14 feet, had been sunk at a slight incline to a depth of 103 feet upon a somewhat wider section of the dike. The ore may be described as a felsite more or less intermixed with quartz, so that while some portions have the characteristic appearance of the latter mineral, others resemble the barren country rock very closely indeed. The who'e veinstone is quite heavily charged with pyrites, which appears as strings of fine crystals along the seams in the ore. A lot of 200 tons is said to have yielded $12.40 per ton at the Keewatin reduction works, although picked quite indiscriminately—a result that should certainly encourage further exploitation.

Another locality which has been brought into notice of late is the Camp Bay district, on the east shore of Whitefish bay. Two miles south of Camp bay is the property of the Boulder Gold Mining Co., of which Mr. Gifford is manager. A shaft was being sunk here on an 11-foot vein, which could be traced for a considerable distance, and although the ore was admitted to be low grade an ample supply could be had at a small expense for mining if the same width were maintained to a fair depth. There is always a possibility that there may be a marked improvement as the workings are extended, but even apart from this hope it is probable from the present aspect that those mines which are working upon ore of fairly uniform value, even if small, will be the more successful in their enterprize.

At Camp Bay, three-quarters of a mile from the water's edge, is the Bully Boy mine, which was idle at the time of our visit. The ore is a series of lenses in a dike of quartz porphyry, which cuts dark green rocks of Keewatin age. The shaft, over 100 feet deep, was partly filled with water, and little could be seen.

A mile further inland from the Bully Boy is the camp of the Combine Gold Mining Co. Development work was being vigorously prosecuted at a number of points, and the outcroppings on various parts of the locations had been carefully stripped. The most interesting deposit is that known as the Jumbo vein, about half a mile east of the camp. There, upon the top of a knoll, is exposed a large body of quartz four feet deep, resembling a true bed with slight dip. An open crosscut had been run into the mass, and it displayed a layer of quartz of the thickness just stated, resting upon the dark green country rock. A short distance away a shaft had been sunk to a depth of 21 feet with no sign of the ore body, so that at the time it was impossible to arrive at any reasonable conclusion as to the nature of this peculiar mass. Another vein 200 feet to the west is three feet wide, and dips 60° northeast; it has been opened up to a slight depth by a test pit, and gives good promise.

On our arrival at the Regina we found that the mill was being entirely reconstructed, and that no underground work was in progress at all. The shaft had reached a depth of 450 feet, and showed great improvement in the vein; a good deal of drifting had also been done and some stoping, in preparation for the start of the new plant. The old equipment, which consisted of ten stamps of 850 lb. each with two Perfection concentrators, has been replaced by seven Tremaine steam stamps and two 3-compartment jigs for concentrating, the tailings from which flow over gyrating amalgamated plates, and thence to waste. The concentrates are ground in Berdan pans, and pass to the cyanide tanks for leaching. The Blake crusher which was formerly used has also been replaced by a Gates gyratory rock breaker, which is said to be more satisfactory. The whole plant is a bold and radical change from the usual types of milling machinery, and the results of the experiment will be of much interest and value to all who are engaged in treating gold ores.

Three miles inland from the foot of Andrew bay lies the Stella property, under the management of Mr. Neil Campbell. There are three shafts at short distances from one another. The first and most easterly is sunk on a large fahlband, and was at the time full of water. The second was for the exploitation of a small but rich vein, and was also full of water. The third is the present working shaft, and had reached a depth of 80 feet. The vein outcrops on the face of a hill at this point, and a tunnel had been driven on the lode for a considerable distance, exposing a mixture of quartz with a varying proportion of country rock, the whole being said to carry gold. At the mouth of the tunnel the shaft had been sunk with a dip of 75° on a body of ore of the same nature as that in the tunnel, and had reached that stage when a steam hoist was necessary.

Our next visit was to the well-known Sultana, which from the water presents the appearance of a bustling village. The new mill is first-class in all its appointments, with an equipment of the most approved design, and the process of ore treatment has been rendered complete by the installation of the chlorination works.

In the Lower Seine Region.

Another of the important gold fields of western Ontario lies at the mouth of Seine River, which, before pouring its waters into Rainy lake, expands into the shallow basin known as Shoal lake.

On the western shore of the latter sheet of water is the Foley mine, the most fully developed property in the district. At the time of our visit no work was being carried on, although the plant was in first-class condition for an immediate commencement.

Three miles to the north lies the Ferguson, Lucky Coon and AD2 properties, all of which were idle.

The mine which is being most actively worked at present is the Randolph or Golden Star, half a mile north of the Ferguson. The mining is done on a dike of felsite which carries lenses of quartz of varying size and shape, and in August the shaft had attained a depth of 300 feet, with a good showing of quartz at the bottom. The dike may be traced somewhat indistinctly up the hill to the south for a considerable distance, while to the north it plunges into a small valley and is lost beneath the drift. Just a short distance to the south of the shaft is the northern edge of that huge eruptive boss of granite upon which are situated the Foley, Ferguson, Lucky Coon, etc., and it is quite possible that the felsite represents an offshoot from the molten granite, although this could not be determined for want of time. The country rocks at and near the shaft are porphyrites. A considerable quantity of ore consisting of a mixture of quartz and felsite, the latter carrying it is said fair values, had accumulated on the dump to be transported by a tramway to the shore of Bad Vermilion lake for milling. At this point a bench had been prepared on the side of the hill for the foundations of the mill, which has since been erected and put into service with satisfactory results. The distribution of the quartz throughout the dike is exceedingly interesting. As has been said above, the lenticular form is the most prevalent, although some of the lenses, to judge from sections afforded by the shaft and levels, must be quite irregular. To illustrate : The ore body in the first level south is at the shaft two feet wide ; a few yards in, and the width increases to eight feet, which continues for a short distance and then splits into two divergent branches, six inches and 10 inches wide, which had not at that time been followed further. An encouraging feature of the deposit is the fact that with one exception the dike at all sections is of good width. It will probably continue also to great depths, and taking into consideration the felsite, which it may be possible to work as a low grade ore, the cost of further development should in a measure be met by the proceeds from the material excavated, even although the richer quartz may be entirely absent for a time.

Lying to the southwest of the Golden Star, at a distance of a mile and a half, is the Emperor, belonging to a Minneapolis company. A shaft was being sunk on two small veins and had reached a depth of 90 feet, showing a marked increase in the width of the lodes. From a level at the bottom of the shaft a crosscut was being driven to a cross vein which could be seen outcropping at some distance to the northwest. Operations were being vigorously carried on, and the company deserves credit for its enterprise.

Adjoining the Emperor to the south is the Decca, which was hardly as much developed as the former property. The shaft, which was being sunk as fast as possible, exposes a good vein, and the venture has good augury of success should the lode prove rich enough.

Both of these properties are situated in the so-called protogine granite, within a few minutes walk of the Ferguson, AD2 and Lucky Coon.

Some eight miles northwestward of Mine Centre is the Olive or Preston gold mine, which has earned a reputation as a producer of the precious metal. The lode is one of the few bedded veins of the district, and is enclosed in dark gray compact schist of Huronian age. The width varies somewhat, but to a depth of 200 feet would perhaps average five inches. The quartz however is rich, and the small Alaska two-stamp mill crushing 12 to 15 tons per six days of 10 hours manages to produce some very nice gold bricks. The ore is rather heavily charged with pyrites, and the concentrates are estimated at five per cent. and quite rich enough to form a valuable asset. For lack of ventilation only a little work was being carried on during our visit, and until the arrival of the compressor plant, which was on its way, not much could be done.

An Encouraging general Outlook

With this our series of visits terminated, as it was impossible for me to visit the mines of the Upper Seine region. Although at a number of points one was disappointed by the abandonment of all work, in many places steady progress was being made, and the continual working of such mines as the Sultana, Regina, Mikado, Golden Star and Olive can hardly be construed otherwise than favorably. A number of prospects were being developed carefully in the different districts, and while the bustle created by the boom of 1897 was lacking, a feeling of determination to explore further had possession of many of the miners and owners to the great benefit of the industry at large. With two thoroughly equipped reduction works at Rat Portage, with cheap water carriage in most cases and low treatment charges, there seems to be no reason that custom work should not prevail on Lake of the Woods as it does in some of the Western States.

Geological Notes.

Intrusive Granite at Wabigoon.

Half a mile south of the town of Wabigoon is the northern edge of a boss of intrusive granite which has not yet been noted on the maps. The mass has a northeasterly and southwesterly diameter of at least two miles, and is of unknown width. The northern contact with the Keewatin rocks of the neighborhood can be seen very well on the shore of a small bay not far from Wabigoon, and presents the same evidence of its intrusive nature as can be seen at other well known localities on Lake of the Woods and Seine river. A small island three-quarters of a mile south is composed entirely of this rock. The granite is somewhat coarse in texture, and is of reddish color. Under the microscope it is seen to consist of crushed quartz, badly weathered felspar and biotite, with numerous accessory crystals of sphene.

Contact of Greenstones and Gneisses.

On location 200SV, three miles northwest of the town, there is an interesting contact, which is unfortunately covered by the drift. In approaching the location a series of massive greenstones of Keewatin age is passed over, and after a short traverse of muskeg an area of fine-grained, evenly laminated gray gneisses is entered on. Interbedded at intervals are beds of mica and tourmaline schist, with much the same texture and close foliation. These are probably members of the Couchiching series, and if so are not likely as far as can be judged at present to contain deposits of any great value.

A Dike within a Dike.

At the Emperor mine, three miles north of Mine Centre, there occurs a system of dikes so curious in certain respects that it has been thought worthy of description. The first is a large body of quartz porphyry, averaging in width 25 feet, which crosses the protogine granite of the locality in an easterly and westerly direction. The dike matter is yellowish in color, with good sized phenocrysts of quartz. It can readily be distinguished from the other rocks of the neighborhood. Passing directly through this once molten mass, and a little to one side, is a second dike consisting of a dark brown rock which has been so badly weathered at the surface that nothing definite can be determined as to its characters. In it are embedded rounded and angular boulders of protogine granite of all sizes and shapes. By tracing the system to the east the younger of the two can be seen to quit in part its host and branch off into the granite, while the other portion continues to accompany the quartz porphyry. The curious feature of one dike occurring within the body of another is quite unusual, and would repay more careful study than would be given in the short time at my disposal. No occurrence of this nature has been recorded by Lawson in his observations on the post-archaean dikes of the locality.

SUMMER MINING CLASSES

Lectures to Prospectors

Instructors taken from the Toronto and Kingston Schools

DURING the season of 1898 the Legislature's appropriation of $1000 for Summer Mining Classes was divided between the School of Practical Science, Toronto, and the School of Mining, Kingston, each school being authorised to select its own instructors for the work. The western portion of the Province was assigned to the Toronto School, which was represented by Mr. J. Watson Bain, one of the teaching staff. The eastern portion was assigned to the Kingston School, which was represented by two of its teachers, Dr. W. L. Goodwin and Prof. William Nicol. An account of the work done by the instructors is here presented.

Mr. Bain's Report

I have the honor to present herewith my report on the Summer Mining Schools which were under your instructions held by me in Western Ontario during the past season.

[illegible]

The programme, which was outlined in Toronto, provided for a course of instruction lasting for two weeks in each of the following places, viz. Port Arthur, Wabigoon, Rat Portage and Mine Centre, [illegible] addresses were to be delivered to the [illegible] with the object of increasing their knowledge of local geology and mineralogy [illegible]

[illegible]

The first class was held in Port Arthur, commencing on the [illegible] of May, and [illegible] students were enrolled. [illegible] Wabigoon, the classes were started on the 25th of May and closed on the 7th of June with a good general attendance. The total number of students was 32. In Rat Portage the session lasted from the 14th to the 29th of June with 15 students enrolled, and in Mine Centre the last class for the season was held from the 20th of July to the 3rd of August with a total of 20 students. The general attendance varied considerably, but whatever the size of the class a lively interest was shown in the work which was being carried on. At each station some of the men attended regularly all the sessions, and these students made very substantial progress, becoming expert in the practical work and adding to their knowledge of the subjects discussed in the lectures. Others, who were less regular, also benefited by the instruction, and it is hoped laid the foundation for a more exact and thorough training.

Wabigoon, Rat Portage and Mine Centre.

Visits of Instruction to the Mines.

At the close of the work in Port Arthur a trip was made to two of the old silver mines, the East and West End Silver Mountain, at which work had commenced once more. On the East End property there were only 5 men and no stop was made, but at the West End 21 men were employed. Capt. Tonkin, who was in charge, informed me that nearly all were foreigners to whom the English language was quite unfamiliar, so that no address was delivered.

From Rat Portage, in company with Mr. J. A. Bow, Inspector of Mines, a series of visits was made to the working mines on Lake of the Woods. At the Mikado a large number of men were employed, and a lecture on the local geology of the district, with a short account of the chief minerals occurring in it, was delivered to an audience consisting of almost the entire force. The Cornucopia, [illegible] [illegible], and Yum-Yum mines were dle, and at Cameron Island mine the r of men was so small that only a short f inspection was paid.

underground work was being carried he Regina, although a number of men ngaged in building the new mill and up the machinery; but as these were ters and engineers, who would not be sted in the subjects under considera- t was not thought advisable to deliver ctures. At the Stella all the miners away in town for a holiday, and the visit was to the Sultana. Here Mr. r, the manager, informed me that al- ll the miners were Swedes, with a very d knowledge of English, and on that t no addresses were given there.

the Seine River district no work was on at the Foley, Lucky Coon, Fer- or AD2, but a large force was employed Golden Star, and a lecture was de- d one afternoon to all who cared to l. The audience was large, and an s similar to that given at the Mikado stened to with appreciable interest. At Imperor mine another lecture was de- d, which was also well attended and eceived.

nce

attendance at the classes is of course nced largely by the state of the mining industry, and this was noticeable during the past summer. In 1897 there was abroad a feeling of ex- ent over the numeral resources of the ry, and many persons were anxious to e to some extent familiar with min- y and geology. In addition, the num- f prospectors was large, so that from two sources very good classes could be d. In the summer of 1898 a reaction et in, and although much steady and l work was being carried on the excite- ery largely subsided and the attendance schools fell off in consequence. If re- be true, the number of prospectors in eld during last summer had diminished -third of what it had been in the pre- year, while many who had been explor- 1897 were hard at work developing reparing their properties for sale.

Course of Instruction.

course of instruction was intended to be as helpful and interesting to prospectors and miners as possible, and on that account the more scientific side of the work was entirely omitted. In illustration, it may not be out of place to give the following syllabus of the course:

Geology.

In geology, the changes that are now taking place at the surface of the earth were described at some length, and it was pointed out that a careful study of the present conditions was the key in a great measure to the records of past action as they have been preserved in the rocks. From this standpoint the formation and significance of different rocks were described and the means of determining their age were discussed, while the importance of these tests in identifying in new districts those rocks which had been proven metalliferous in older and better known regions was pointed out. In dynamical geology, the folding of rocks and the production of faults and fissures, with their significance, were treated in detail, while the action of volcanoes, important as that has been in western Ontario, was described somewhat thoroughly. When the elementary work had received attention, the local geology was developed, and the relations of the rocks in the vicinity were described. As might be expected, this particular branch of the work attracted more attention than any of the others, and I was assured upon several occasions that the field work could afterwards be prosecuted with much clearer ideas as to the relations of the different rocks, an end which was well worthy of the time spent in reaching it.

Lithology.

Since a prospector spends the greater part of his time among the rocks, the subject of lithology received careful attention. In the lectures the origin and mineralogical composition of rocks were described, and afterwards field determination was practised upon specimens gathered from the immediate vicinity as far as possible.

Mineralogy.

In mineralogy, the value of the physical properties, color, streak, hardness, etc., for the rapid determination of minerals was demonstrated by practice with specimens, and lectures were given describing the common minerals of the country, with their economic value and identification. Each student was supplied with blowpipe, forceps, platinum wire, etc., and was taught to use them for the determination of minerals. After a fair degree of proficiency had been attained, minerals unknown to the student were given for examination, and were in most cases named correctly.

Assays for Gold and Silver

The field assays for gold and silver ores by which the values may be ascertained in the field with simple apparatus were shown in practice, and a number of samples belonging to members of the classes were tested in this manner.

The Mineral Collections

The mineral collections which had been provided by the Bureau of Mines at Port Arthur and Rat Portage were of great service, and enabled the students to become familiar with more minerals than could be carried about in a travelling collection. Any person who is interested has access at all times to the collections to study the specimens, or compare them with others which he is anxious to determine. The benefits thus conferred will be apparent to everyone, and it is undoubtedly a step which is in the best interests of the mining industry.

For great courtesy in providing accommodation I have to thank Mr. D. F. Burke of Port Arthur, the town of Wabigoon, the town council of Rat Portage, and L Hamel & Co. of Mine Centre; and my acknowledgments are also due to many gentlemen who assisted me in various ways. J. W. B.

Dr. Goodwin's Report.

I beg to submit the following report of mining classes conducted during June and July by myself and Professor Nicol:

The places selected for holding the classes were Parry Sound and Mattawa. I left Kingston on June 14th and went to Ottawa to take the Ottawa and Parry Sound Railway for the west. On the way from Ottawa to Parry Sound I took two days to go west to Mattawa and arrange for a class there. The mayor and council of Mattawa received the suggestion favorably, and it was decided to begin work there early in July.

At Parry Sound

Proceeding to Parry Sound, I was there joined by Professor Nicol. We were given the fire hall in which to hold classes, and tables and seats were provided by the town council. Considerable prospecting is being done in the neighborhood of Parry Sound, and discoveries of iron and copper ore have been made. Garnets are very abundant, and might be mined as an abrasive. The prospectors were eager for instruction in mineralogy and geology, and some came from long distances to attend the class. The total number of students who attended the class was fifty-two, and the average daily attendance was about twenty—very good considering the long distances and the difficulty of arranging a time table to suit the circumstances of all. The classes opened on June 20th and closed on July 2nd. A number of prospects and test pits were visited at the request of owners and others interested. Bornite, chalcocite and chalcopyrite are often found, but so far not in paying quantities. At the Wilcox prospect zincblende and pyrrhotite were noticed in considerable quantities; also a little molybdenite. Those students of the class who were able to accompany us on these excursions had the advantage of examining the minerals and rocks in situ. Two classes were held each day, one at 9 a.m. and one at 6.30 p.m., each class lasting for about two hours. The greater part of the time was spent in the examination of mineral specimens from our collection, as well as large numbers brought in by members of the class, some of whom became quite expert in identifying minerals by the aid of a simple table printed especially for the work of these classes.

At Mattawa

We left Parry Sound on July 2nd and distributed corundum specimens at Kearney, Rainy Lake, Canoe Lake, Cache Lake, Whitney, Barry's Bay and Killaloe, points on the line of the Ottawa and Arnprior Railway. Reaching Mattawa on July 3rd we began classes there the next day. The council had provided excellent accommodation in the town hall, and the success of the classes there, as in Parry Sound, was due largely to the energetic manner in which the subject was taken up by the mayor and council, and by citizens interested in minerals and mining. The opening of the classes had been well advertised, and they were begun with a large number in attendance. The total number who did systematic work was 73, and the average attendance was about 45. Two classes were held each day, one from 9 a.m. to 11.30 a.m., and a second from 6 p.m. until dark. The students brought in large numbers of specimens for examination, and many specimens were determined at odd times, as those who had them were met during the day. In addition to those counted as students, there were many visitors who came in to examine the mineral and rock specimens and to ask for information. Several experienced prospectors have been at work up the Ottawa and around lake Temiscamingue. The Huronian areas there are receiving attention. Good specimens of magnetite and limonite, said to have been obtained within a few miles of Mattawa, were brought in by members of the class. The instruction was confined mostly to identification of minerals and rocks and to elementary geology ; but some time was given to methods of sampling and to the relations of geology to prospecting. Many members of the class identified upwards of 50 specimens of minerals and rocks. The classes closed on July 11th.

Practical results.

There can be no doubt that these outside mining classes are serving at least two purposes—first, to call attention to minerals in general and to valuable minerals in particular ; and secondly, to give professional and occasional prospectors correct ideas as to how to find out the value of a discovery. The prospector has often a very limited knowledge of minerals, and may miss valuable discoveries which even a small extension of his acquaintance with mineral species would enable him to make. He also has sometimes quite incorrect ideas about sampling for assay. For this reason it is well to give special attention to this subject We also found it useful to carry an assay outfit with us, not for the purpose of teaching assaying, but to illustrate the nature of the process of assaying for gold and silver. This serves to warn prospectors against incompetent assayers.

Thanks are due to the many citizens of Parry Sound and Mattawa who assisted to make our work pleasant, and to the Canada Atlantic and Canadian Pacific Railways which gave free transportation for our heavy luggage. W. L. G.

PROVINCIAL ASSAY OFFICE

By J. Walter Wells

I HAVE the honor to present the first annual report of the Provincial Assay Office, which was opened for public assay and analytical work on July 3, 1898. The report includes the operations of the office up to December 31, 1898.

The Record for Six Months.

Organizing the Office.

Instructions were given me by the Director of the Bureau of Mines on May 29 to proceed to Belleville and attend a meeting of the City Council when the agreement between the Bureau and the Council was made. The latter leased the present quarters of the Laboratory for a period of one year at a rental of $200 free from taxes. Three days were spent in Montreal personally selecting apparatus and supplies. The occupant of the two rooms in the Falkener block provided by the Council moved out on June 10, and July 3 the laboratory work was started, the intervening time being spent in cleaning the rooms, setting up furnaces and apparatus and directing the plumbing and carpentry work.

Advertisements were inserted in the local newspapers and the following circular was sent out to the Crown Lands agents and to the various mining and prospecting centres :

PROVINCIAL ASSAY OFFICE.

The Assay Office and Laboratory equipped at Belleville under direction of the Bureau of Mines is prepared to assay and analyze ores at the following rates :

Assay in duplicate for	1 sample.	3 to 5 samples at one time, each.	6 or more samples at one time, each.
Gold	$1 00	$0 90	$0 75
Silver	1 00	0 90	0 75
Gold and Silver	1 25	1 00	0 90
Copper	1 25	1 00	0 90
Arsenic	1 25	1 00	0 90
Nickel	3 00	2 40	2 00
Lead	1 25	1 00	0 90
Iron Ores :			
Metallic Iron	0 50	0 40	0 35
Silica	0 75	0 60	0 45
Sulphur	1 00	0 90	0 75
Phosphorus	1 50	1 20	0 90
Titanium	1 50	1 20	0 90
Manganese	2 50	2 00	1 80
Corundum			
Alumina	2 00	1 80	1 50
Silica	0 75	0 60	0 45
Iron	0 50	0 40	0 35

Analyses of Limestones, Marls, Clays, Peat and Economic Minerals at corresponding rates.

Gold ores tested as to free-milling qualities by Amalgamation Assay.

DIRECTIONS for proper Selection of Sample : If the commercial value of a deposit is desired, an average sample for assay may be taken thus : Detach a small piece (¼ to ½ lb.) every 10 or 12 inches across the whole width of the deposit. Repeat this operation every 8 or 10 yards, going the whole length of the deposit. The total amount of ore collected represents an average sample. If the deposit is opened up, samples from each shaft and level taken in a similar way must be included with surface samples. Amount of ore for average sample, 5 to 40 lb. Deposits of variable character (e.g. gold ores) require more than those of uniform character (e.g. iron ores.)

DIRECTIONS for Quartering Down—Large quantities of ore for assaying may be reduced by "quartering down" thus : Crush the whole amount to size of a walnut make into a round heap, mix thoroughly and divide into four equal parts. Select one quarter, crush to size of a bean, mix thoroughly and quarter as before. Proceed in the same manner until the quantity is reduced to 1 or 2 lb. weight.

DIRECTIONS for sending Samples to be Assayed—Crushed samples representing the average of large quantities, or samples less than 5 lb. in weight, may be sent by mail as 5th class matter (1c. per oz., limit weight 5 lb.) or per parcel post (1c. per 4 oz., limit weight 24 oz.) Place in a canvas bag, tie securely, and address to the undersigned. Write your own name and address plainly on the tag and send instructions with money in payment of fees in a separate letter. When more than one sample is sent at one time, each sample must be distinctly marked or numbered, so that they may be identified by instructions in letter.

TERMS—Money in payment for assays and analyses must invariably accompany ore. Assays and analyses are confirmed in each case by a check or duplicate and guaranteed correct. The pulp of each sample is held for future reference.

J. WALTER WELLS, B. Sc.,
Assayer to the Bureau of Mines,
Belleville, Ontario.

Operations of the Year.

Shortly after the announcement of the opening of the Laboratory by the Bureau, samples for assay were sent in from various points. The receipt of samples has steadily increased in number up to the time of writing. The first certificate was issued on July 5, and to 31 December 239 samples were received for assay or analysis. Of this number 41 were done for the Bureau of Mines, on which no fees were collected.

The total number of assays made was 227, and the total number of analyses 116, being in all 343 tests or determinations on the 239 samples.

The Scale of Fees.

The fees charged by the office for assays and analyses are nominal. They are based on the cost of the materials—chemicals, fuel, etc.—used in each operation. The fees for gold, arsenic and iron ores are relatively lower than for others, as most of the prospecting and development work is done on these ores. As may be seen in the circular, a liberal discount is allowed on a number of samples sent in at one time. Up to 31 December the fees collected by the office aggregated $241.30. The cash receipts were forwarded to the Bureau of Mines at the end of each month as follows :

July	$17 25
August	30 75
September	57 25
October	66 30
November	36 15
December	43 60
Total	$241 30

Some difficulty was experienced in collecting fees, and in several instances samples were treated and certificates not issued as no fees were received.

Samples for Identification.

Numerous samples were received for identification. In each case a full description of the rock or mineral as determined by field tests was given, accompanied by information as to uses, market value, probable value of sample, etc. No fee is charged for this class of work, although in many cases it involves the getting of the mineral in solution and applying wet qualitative separation tests.[1] This work often saves an assay or analysis, and is greatly appreciated by the public. No record was kept of samples received and reported on in this way until November 6. From that date to the end of the year forty-five samples were reported on, either personally or by letter. In each case, when necessary, full information was given as to commercial uses, market value, etc.

Trips to the Mining Centres.

Two trips were made to the back country to become better acquainted with the district. One of these was to Madoc and the surrounding country, where the various deposits were visited as far north as the Craig gold mine in Tudor township. The other was to the Coe Hill iron ore mines and the adjacent deposits of iron ore. Samples from each of the deposits visited were collected and placed on exhibit. I am often obliged to answer enquiries regarding the minerals in Eastern Ontario, and the most satisfactory method of obtaining reliable information is to visit the deposits personally.

Equipment of the Laboratory.

Equipment for Assaying Work.

The Laboratory is at present located on the ground floor of two rooms. The equipment is adapted to the needs of a Laboratory prepared for assay work on gold, silver, copper, lead and nickel ores ; also for the quantitative analysis of common economic minerals and ores, such as those of iron, corundum, nickel, zinc, lead, peat and coal. The assay part of the Laboratory has a first-class modern equipment. For those assays requiring fluxing down or fusion a complete set of gas furnaces, consisting of roasting, crucible fusion, scarification and cupellation furnaces is used, together with a universal Hoskins' muffle furnace heated by gasoline under pressure. For testing gold ores as to free-milling qualities, a laboratory arrastra together with amalgamation pans is used with good results. Copper and nickel estimations are done by both fire and electrolytic methods, the metal in the ore being deposited in the latter method on platinum cylinders by an electric current from a set of gravity cells. In the fire assay the system of breaking crucibles, rather than pouring and using again, is employed. The ordinary requisites, such as pulp balances, ore scales, fluxes of various kinds, reducing agents etc. are in use.

The ore samples received for treatment are prepared by crushing in a small hand crusher and pulverized from 80 to 100 mesh in a mortar. With regard to the sampling down of large quantities of ore sent in for treatment, the commonly approved methods are adopted. All assays and analyses are done in duplicate, the results being checked off so that errors can be reduced to a minimum. This method can not be adopted however unless a sufficiently large quantity of ore is received. The samples are in each case, both the rough and the pulp, retained for future reference. The Laboratory is prepared to send out the returns on samples received for gold, silver and copper assays the same day that the samples are delivered providing there is no rush. Under present circumstances the Laboratory cannot handle more than a limited number of samples for gold and silver assay in duplicate per day. A fine Becker assay bead balance in use allows the weighing of gold residues down to 20c. per ton in gold.

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[1] A scale of fees for this class of work has been adopted for 1899.

Equipment for Analytical Work

The analytical part of the Laboratory is not altogether satisfactory as regards location and equipment. Since expenditure of capital often depends on the results of an analysis of ores, a first-class equipment in proper quarters is a necessity. In fitting up the Laboratory it was not expected that many samples for quantitative analysis would be received at first, but the record for the past six months shows considerable work done in this line and justifies the fitting up of this part of the Laboratory in a more elaborate manner. At present analyses of ores are done in the front room, which is also used as an office and contains three cabinets for the exhibit of mineral specimens. The public has free access to this room, which in some measure interferes with careful analytical work.

As regards methods used, it may be said that none but the well-tried ones are pursued. The ores are prepared by crushing, pulverizing and in most cases reducing to an impalpable powder in agate mortars before treatment with acids or fluxes necessary in making the ore pass into solution. For the latter process a fume cupboard having burners, baths, etc., is used. This is connected with the outside air by a horizontal galvanized iron pipe, at the end of which is an exhaust fan run by a small water motor drawing the fumes to the outside air. This is not satisfactory, as a fume cupboard properly constructed should have a strong direct vertical current of air, preferably that of a large chimney flue. There are three working tables. One is for volumetric estimations of iron, zinc, etc. supplied with standardized solutions. Another is for general purposes, being supplied with water taps, sink, filter pump, steam bath connected to exhaust fan, shelves for solutions and cupboards underneath for various apparatus. The third is for ignition of precipitates and fusion of ores, being supplied with a bath, platinum crucibles, blast lamp, etc. Distilled water, used almost exclusively, is secured by an automatic Jewell still heated by gas. A Becker analytical balance reading to one-tenth milligram is used in weighing precipitates. The pulp balance, assay bead balance and analytical balance, each with a set of weights, are at present placed in a vault at the back of the suite of rooms. This is very damp in winter, but is otherwise satisfactory.

Forms of Certificates

The following forms of certificates are used in sending out reports on samples. They seem to answer the purpose fairly well, being convenient to carry in the pocket and for reference.

No. Made for Date

Sample Marked

Assayed in Duplicate for

Laboratory of the Assayer to the Bureau of Mines, Belleville, Ontario. J. Walter Wells, B. Sc., Official Assayer.

No.	Gold, oz. per ton.	Value per ton of ore.	Silver, oz. per ton.	Value per ton of ore.

Assayer.

No. Date Sample Marked

Analysed in Duplicate for

Laboratory of the Assayer to the Bureau of Mines, Belleville, Ontario. J. Walter Wells, B. Sc., Official Assayer.

No.	Metallic Iron, per cent.	Silica, per cent.	Sulphur, per cent.	Phosphorus, per cent.

Analyses made for

Chemist.

State Assay Offices Elsewhere.

Several of the mining States of America, notably Colorado, have at some period in their history maintained State assay offices.

ral practice has been to maintain
office for a more or less indefinite
time during the prospecting and
developing stages of the mineral
industry. This has been done by
Governments as a direct aid in
ıg the industry. In almost every
he action has been received with
the prospectors, mineral property
nd mining men in general who
he assaying and analyses of ores.
e mining industry is best developed,
e aid seems to be the least, the
assay or analytical work being done
ommercial laboratories in proximity
nining centres. States having a
f Mines as a sub-department of the
ent invariably maintain an assay
y in connection with the depart-
ich in several instances are located
ning districts.

f the States maintain a Geological
taff in connection with the State
y or School of Mines, and all of
itutions have testing laboratories—
nalytical and metallurgical—some
borate and expensive equipments.
of Colorado, the principal mining
he Union, has for many years con-
State assay office and a Mining
at Denver, where the economic
of that district have been elaborately
d by means of exhibits, lectures,
, etc. A considerable amount of
ems to have been spent by the State
y. The results have amply justified
y, as Colorado has steadily advanced
s production of metals, such as gold,
l lead.

rovince of British Columbia has
ed a Government assay office for
twenty years. There seems to be
that it has proved a stimulant to
ral industry in that Province by
prospectors and mining men reliable
upon which they might invite or
rest capital. The British Columbia
fice is at present located in a build-
tructed for the purpose, and the
ıt is to be elaborate.

seems to be a movement on foot at present in that Province to prevent the Government Laboratory from entering into competition with private laboratories. The proposal does not seek to abolish the office entirely, but to limit its function to that of acting as an umpire assayer; that is, in case of dispute between parties handling ore the certificate issued by the Government Laboratory on the value of the ore in question is to be accepted as final. It is suggested by the petitioners to the Government in regard to this matter that the fees charged for the latter work should be double the ordinary commercial rates, thus compensating for the limited function of the Laboratory.

In Hamburg, Germany, there is a Government assay office which has been operating since 1895 with remarkable success.

Schemes of Fees in Operation.

With regard to the fees charged for assays and analyses, various practices seem to be followed. The Government assay office of British Columbia charges the usual rates, and a comparison of the fees as copied from the list of official charges with the fees charged by the Ontario Laboratory may be of interest.

Minerals.	B. C. office.	Ontario office.
Gold and Silver	$1 50	$1 25
Gold, Silver, Copper together	3 00	2 50
Copper	2 00	1 25
Lead	1 50	1 25
Iron	3 00	0 50
Nickel, quantitative assay	10 00	3 00
Zinc	5 00	2 00

The quantitative analysis of ore in British Columbia is $25 to $50 according to constituents, while in Ontario it is $5 to $10.

Some of the States in the United States have followed the practice of doing the work for the public free of charge, lodging discretionary powers with the assayer as to what samples are worth testing. Other States, on the contrary, have charged nominal fees to prevent the testing of worthless samples which might otherwise be sent in for examination.

In Ontario as in other countries a great deal of unreliable assay and analytical work has been done which has encouraged in some cases the outlay of capital without reason. Work done by the Government tends to prevent this, and the results are guaranteed so far as the samples are concerned. A number of such unreliable reports, more especially in gold and silver assays, have come under my observation during the last year and it has been shown that those who have paid for such assays have been simply humbugged.

State of the Mineral Industry in Eastern Ontario.

Evidences of a substantial industry.

The outlook for the mineral industry in eastern Ontario is encouraging, as there seems to be no doubt as to the existence of workable deposits of various economic minerals. More capital is being spent at present in actual development than ever before in the history of the district, and the mines treating ore are getting good results. The ores showing the most activity are those of gold, iron, arsenic and lead.

Gold.

As for gold, three mines are raising ore for treatment. At the Belmont mine, owned and worked by the Cordova Exploration Co., of London, England, a low-grade quartz carrying a small percentage of sulphurets is successfully treated by a well-managed ten-stamp mill made by the W. B. Hamilton Co. of Peterboro. At the Deloro mine, near Marmora, owned by the Canadian Gold Fields Syndicate Co., of London, England, an arsenical ore is treated by a modern Fraser and Chalmers ten-stamp mill, the concentrates being treated by the Sulman bromo-cyanide bleaching process with excellent results. At the Boerth mine, near Ardoch, a Detroit company is working a free milling quartz, apparently high grade, which will shortly be treated by amalgamation. Several other properties are being developed with every promise of becoming mines, notably the Diamond at Queensboro, an arsenical ore body carrying high values in gold.

Arsenic

As for white arsenic, small quantities of fair quality have been made in trial furnaces at the Toronto Smelting Co's smelting works at Madoc; also by Mr. Joseph James at Actinolite. This product found a ready sale in the New York markets at a fair price. There seems to be no reason why capital should not find a safe investment in the manufacture of white arsenic and its products, as fuel, labor, an high grade arsenical ore can be got cheapl in North Hastings. White arsenic is risin in value owing to apparently diminishing or supplies in Germany and England, whic now control the market, combined wit increasing uses of the article and the vario products made from it in the arts. Whit arsenic is quoted in the New York markets an average price of $80 per ton. The proce of extracting it from the North Hastin arsenical ores is comparatively simple a should yield a fair profit on money investe

Iron Ores.

Iron ores (hematite) have been shipp steadily from two deposits near Madoc, a from Calabogie station on the and P. Railway to the Hamilt blast furnace. A magnetic iron ore has al been worked near Malone on the C. O. R. also at Bedford on the K. and P. Railway The Deseronto Iron Co., making charcoal pi iron, is also in the market for Ontario iro ores of Bessemer quality.

The large number of iron ores received fo analyses at this Laboratory indicates a considerable activity in this district. Judgin from the samples analyzed and from person inspection, there seems to be numerou deposits of magnetite of more or less exte which may be classed as lean ores. Some these can no doubt be made into Bessem grade by magnetic concentration. Simil deposits of lean magnetic iron ores are bein successfully worked in New Jersey and th Southern States by a system of magnet concentration. Much of the Swedish cha coal iron which commands such a high pri in the markets is made from more or less lo grade magnetic iron ores. With an acti demand for iron ores in Ontario, there seem to be no reason why these low grade ores ca not be placed on the market at a profit.

Galena.

Lead ore (galena) is being shipped to Belgium from a deposit near Bannockburn Hastings county. It is reported that a lead smelter is to be erected at Madoc.

A few shipments of felspar from Bird's Creek, in Hastings, have been sent to the English potteries, which pay about $8 pe ton delivered at Liverpool. There are severa odies of almost pure orthoclase felspar in this county, which are probably of commercial value as fluxes in the acture of pottery ware of various .

corundum deposits in North Hastings enfrew show no active development as m. yet, but a few good properties owned by private parties have ed hands.

limestone quarries at Crookston stad at Point Ann, near Belleville, have se. been worked steadily for the past six months with a large staff of men quarries. The Inspector's report will bt give a description of the operations. mall shipment of sodalite from the line syenite areas in Dungannon township was made to a Philadelphia jewellery firm, to be made up into ents.

Future of the Assay Office.

Laboratory needs more room so that alytical part may be put in a more the ory. satisfactory condition. A separate room is also needed for the display eral samples which are sent in to be on exhibit to such an extent that it is ing impossible to make room for them present conditions. As under the ent with the Bureau of Mines the il is to provide suitable quarters for the the office, it is earnestly advised that as possible the Laboratory be given e of a building with the requisite t of room suitable to the present needs office.[2] No attempt has been made to make a systematic collection of the ores and minerals of this district, as my instructions are to attend to Laboratory work for the present.

It is the desire of many business men in Belleville and the mining district in North Hastings that a Bureau of Information be maintained in connection with the Laboratory for an exhibition of the economic minerals of eastern Ontario as well as assisting in every way possible to advertise the district, so that legitimate capital may be induced to operate. Such a function will no doubt fill a public need in this district, but it will require an addition to the office staff. Taking the action of the State of Colorado as an example with regard to this matter, the scheme properly carried out would probably meet with considerable success.

As may be seen by the record of work done by the Laboratory for the past six months, the location of the office seems to be central and convenient to the mining public. Belleville has good communications with all parts of eastern Ontario.

Correspondence and Visitors.

The letter book shows that 287 letters were sent out exclusive of certificates, circulars and reports on specimens for identification. For the first two months a large number of circulars were sent out by mail to the various centres and to mining men. The letter file shows that 190 letters were received at the office. For the first two months a large number of visitors called at the office, more through curiosity than on business. This was a considerable hindrance to the Laboratory work, but my instructions are to receive all visitors with courtesy.

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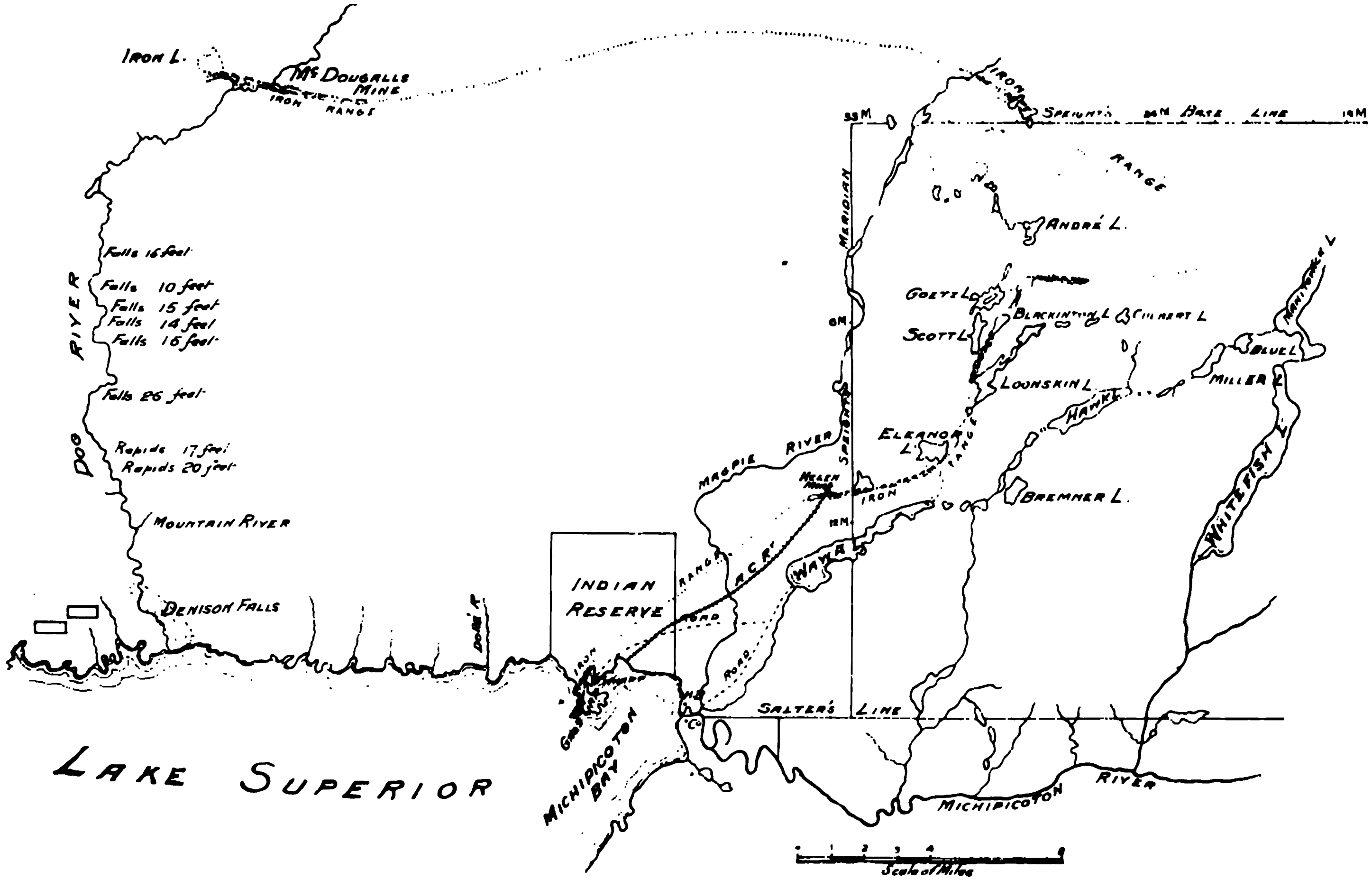
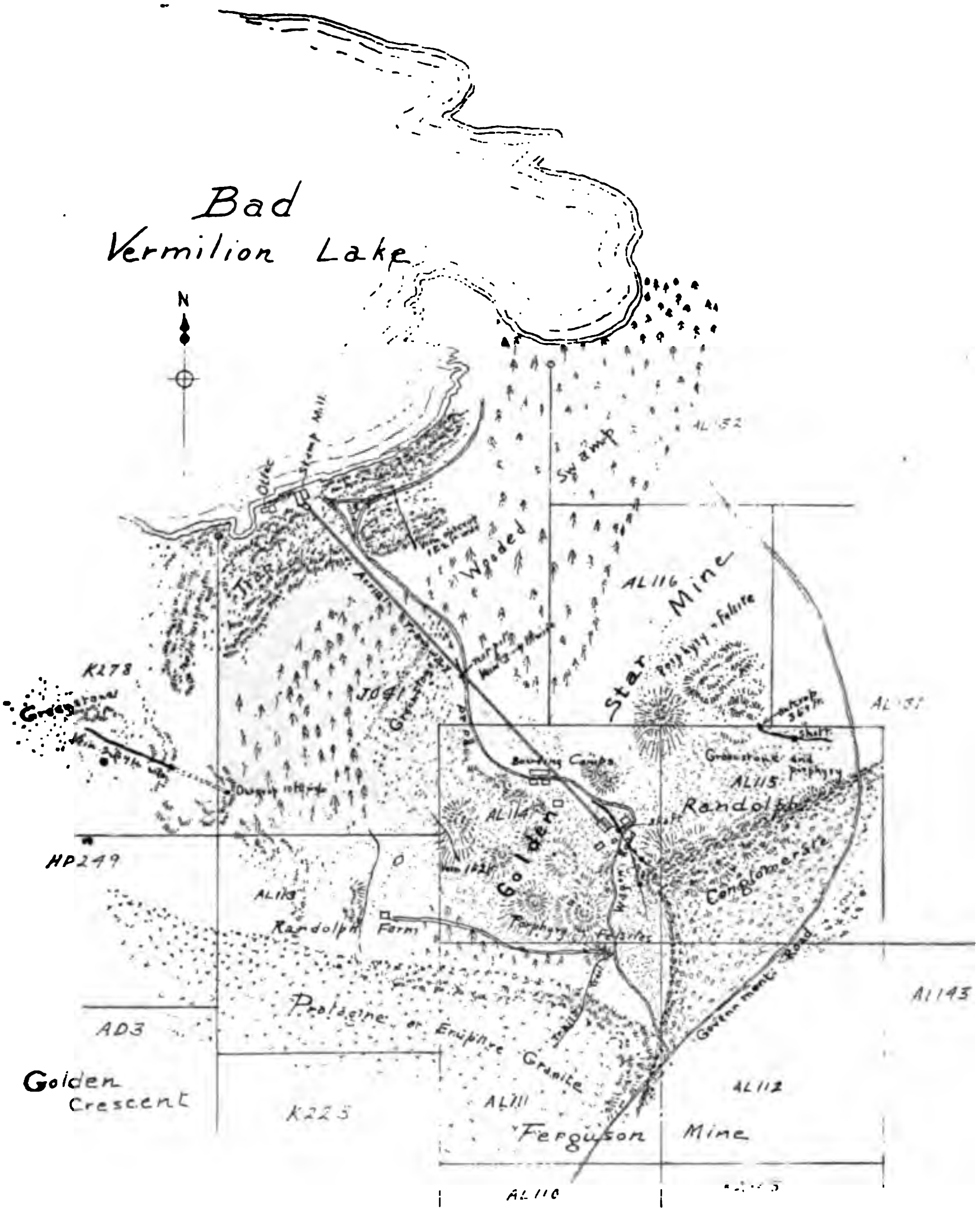
table quarters in another building have been ed by the Council during the present year and the office is now well housed.

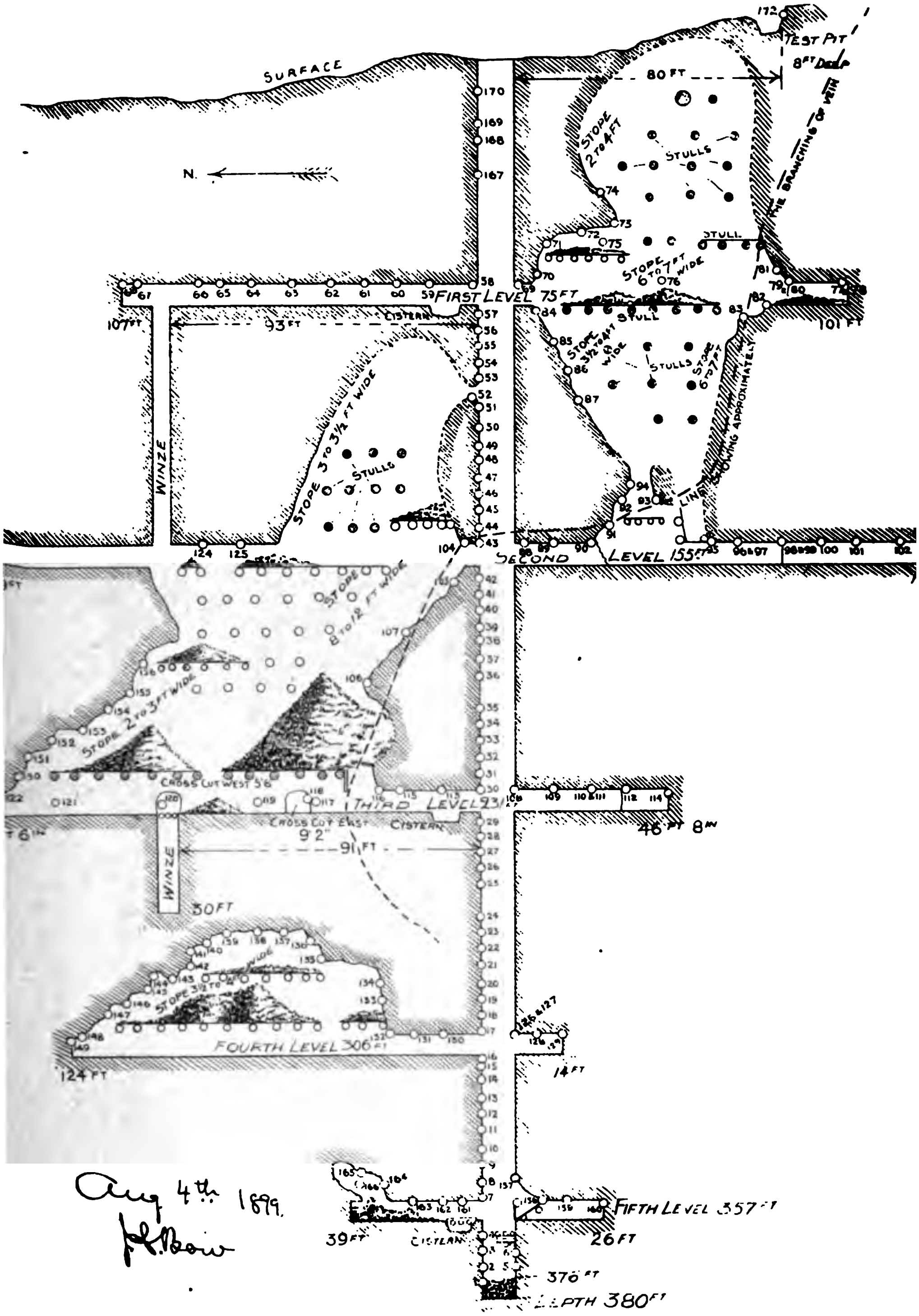


Map of the Michipicoton Iron Region By A. P. Coleman and A. B. Willmott, 1899. Scale 4 miles to an inch pp. 254-258



Plan of Golden Star, J041
and adjoining Locations.
Scale -- 10 chains - 1in.

See pp. 264-271.



Aug 4th 1899.
J.H. Bow

Longitudinal section of the Golden Star Mine, pp. 264-271

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